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January 20, 2012

John W. Watson
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John.Watson@bakermckenzie.com

Via Messenger

Attn: Compliance Tracker, AE-17J
Air Enforcement and Compliance Assurance Branch
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604

RE: In Re: Peabody Midwest Mining, LLC - Bear Rune Mine
Request to Provide Information Pursuant to the Clean Air Act,
dated November 17, 2011

To Whom It May Concern:

This letter and attached enclosures constitutes the timely response of Peabody Midwest Mining, LLC ("PMM") to U.S. EPA's Request to Provide Information Pursuant to the Clean Air Act, dated November 11, 2011, (the "114 Request") with respect to PMM's Bear Run Mine operation located at 7255 East CR 600 South, Carlisle, Indiana 47838 (the "Bear Run Mine").

As referenced briefly in my prior conversations with Kathleen Schnieders, Associate Regional Counsel at U.S. EPA Region V, PMM believes that the Agency's 114 Request, which requests that PMM develop and implement an expansive and exceedingly costly dust monitoring program at the Bear Run Mine, is overly burdensome and otherwise unnecessary to fulfill any legitimate purposes under the Clean Air Act, including assessing compliance with National Ambient Air Quality Standards. Over the course of the past year or so, PMM has received isolated and intermittent complaints from residents living in the vicinity of the Bear Run Mine regarding dust from the Mine operations. These complaints have primarily occurred during particularly dry weather patterns. In each case, PMM has investigated the nature and substance of these complaints and spoken directly with the aggrieved parties. PMM continues to monitor dust associated with its mining operations and is actively implementing appropriate measures, and exploring additional technologies and operating practices, to ensure full compliance with its regulatory obligations.

As U.S. EPA is well aware, PMM holds a Minor Source Operating Permit from the Indiana Department of Environmental Management ("IDEM"), pursuant to IDEM's U.S. EPA approved Minor Source Operating Permit Program, 326 IAC 2-6.1.1, (the "IDEM Permit"), for the management of fugitive dust from the Bear Run Mine. The IDEM Permit contains specific emissions limitations for fugitive dust. To ensure PMM's compliance with these emissions limitations, PMM's Permit requires the preparation and implementation of a Fugitive Dust Management Plan, attached as Exhibit A to the Permit.

PMM has developed the necessary processes and procedures, and has provided effective training to its employees, to ensure ongoing compliance with the requirements of its Fugitive Dust Management Plan during mining operations at the Bear Run Mine. PMM is committed to the effective management of dust at the Mine and has invested a tremendous amount of time and financial resources to fulfill this important operating objective. By way of one example, PMM recently purchased two 44,000 gallon capacity water trucks that are continuously employed during active mining operations to manage dust.

Other dust management activities have also been evaluated and implemented in response to extreme weather conditions and unanticipated operational challenges. Over the course of the last year or more, PMM has implemented several changes to its operations to further control dust. These have included limiting blasting operations during unfavorable wind conditions and minimizing the drop height of its dragline bucket. PMM is currently evaluating further revisions to its blasting procedures to reduce the pulverization of rock during blasting operations. Other dust control mechanisms have also been implemented or are currently under evaluation, including use of chemical suppressants on haul roads, using conveyors instead of dump trucks where feasible, and evaluating fogger and water cannon technologies during high intensity mining activities. These efforts are ongoing and will continue to yield improved operating performance.

It is worthy to note that these additional dust management efforts have been undertaken in coordination with IDEM, in its capacity as the responsible permitting authority. Notwithstanding the receipt of isolated dust complaints from Bear Run Mine neighbors, IDEM has not found any IDEM Permit violations associated with fugitive dust during PMM's operations at the Mine.

In light of the current status of its Bear Run Mine operations, PMM maintains that the Agency's request is not justified. Nonetheless, PMM is prepared to cooperate with the Agency and, as promised, is proposing, as fully documented in Appendix A hereto, an appropriately tailored and cost effective alternative monitoring program designed to fulfill the presumed objectives of U.S. EPA's 114 Request. The proposed monitoring program was developed by McVehil-Monnett Associates, Inc. ("McVehil-Monnett"), a recognized environmental consulting expert to the mining industry, and in consultation with IDEM to ensure consistency with IDEM's regulations, policies and directives. The proposed monitoring plan was also prepared specifically to address the comments and direction of IDEM on required elements of the plan as set forth in the December 6, 2011 letter from Keith Baugues, Assistant Commissioner at IDEM, to Cheryl Newton, at U.S. EPA Region V.

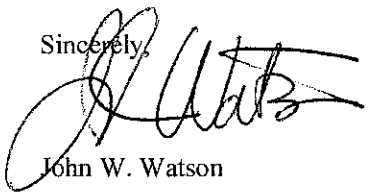
Finally, in addition to requesting implementation of a dust monitoring plan, the Agency's 114 Request also seeks the collection of limited coal samples for lead analysis. PMM already analyses the Bear Run Mine coal for lead on a regular basis. As summarized in the enclosed memorandum from McVehil-Monnett (Appendix B), a review of Mine coal data

suggests lead content in Bear Run Mine coal to be below background concentrations for naturally occurring lead in Indiana soils. No additional analysis is therefore warranted.

Notwithstanding anything to the contrary set forth herein, nothing in the response provided by PMM should be construed as an admission of any liability under law, nor an acknowledgement that U.S. EPA's 114 Request is otherwise justified or appropriate. For its part, PMM denies any allegations of violations or other wrongdoing and affirmatively asserts that the Agency lacks the legal basis to pursue the 114 Request. PMM therefore expressly reserves all of its rights with respect to this matter, including its right to reexamine its proposed monitoring plan in light of Agency comments.

Given the nature of U.S. EPA's request, this response is being submitted in hard copy format. We are happy to provide an electronic copy upon request from the Agency. Please contact me should you have any questions regarding PMM's response to the Agency's 114 Request.

Sincerely,



John W. Watson

cc: Phil Perry, IDEM

Attachments

STATEMENT OF CERTIFICATION

I certify under penalty of law that I have examined the Bear Run Fugitive Dust Monitoring Plan prepared by McVehil-Monnett Associaes, Inc, and am familiar with, the contents of the enclosed Plan, including all attachments. Based on my inquiry of those individuals with primary responsibility for preparing the Plan, I certify that the information contained in the Plan is, to the best of my knowledge and belief, true and complete. I am aware that there are significant penalties for knowingly submitting false statements and information, including the possibility of fines or imprisonment pursuant to Section 113(c)(2) of the Act and 18 U.S.C. §§ 1001 and 1341.

By Mark R. Yingling
(Signature)

VP Environmental Services
(Title)

1-19-12
(Date)

APPENDIX A

Bear Run Mine Fugitive Dust Monitoring Plan

Prepared by McVehil-Monnett Associates, Inc.
44 Inverness Drive East
Building C
Englewood, CO 80112

Prepared for Peabody Midwest Mining, LLC
7100 Eagle Crest Boulevard
Suite 200
Evansville, IN 47715

January 20, 2012

Table of Contents

List of Tables

Appendices

1.0 INTRODUCTION

Peabody Midwest Mining, LLC (PMM) has retained McVehil-Monnett Associates, Inc. (MMA) to develop a plan to conduct ambient monitoring for PM_{10} and meteorological variables over a multi-month period at the Bear Run Mine in Carlisle, Indiana. PM_{10} will be monitored on a 24-hour integrated basis utilizing federal reference method (FRM) samplers at three (3) locations. Siting of the monitors will be determined based on established regulatory methodologies and will rely on relevant site specific information. The process for siting monitors is discussed in detail in the following section.

PM_{10} sampling will be conducted in accord with all relevant requirements as described in Section 2.11 of the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods". Quality assurance/quality control procedures are addressed in Section 3.0, below and will be described in detail in a Quality Assurance Project Plan (QAPP) that meets the "Guidance for Quality Assurance Project Plans, EPA QA/G5", EPA/240/R-02/009, December 2002, once sampling sites are selected.

The PM_{10} monitoring program will be further supported with the collection of on-site meteorological data. A 10-meter tower will be installed at one of the three PM_{10} sites where wind speed and wind direction will be measured at 10 meters and temperature and barometric pressure will be measured at 2 meters. Precipitation will be measured near ground level with a heated gauge. All meteorological measurements will be collected in accord with the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0" and any specific procedures as provided in the manufacturers operations manuals. See Table 1 for meteorological sensors listings and Appendix A for instrument specifications.

PMM will initiate all monitoring on June 1, 2012 assuming timely approval of the QAPP and monitoring site locations by the EPA. Said monitoring will continue for four (4) months during the dry summer period when evapotranspiration and dust conditions are

at their highest levels. Data reports will be generated on a monthly basis and submitted to EPA on the schedule described in Section 5.0 below.

2.0 Monitor Siting and Installation

PMM will select two monitoring sites in predominantly "downwind" directions from active mining areas and one site "upwind" of the mine. Samplers will be located in "ambient air" in areas not presently part of PMM's active mining operation. Consistent with accepted regulatory directives, the PM_{10} monitors will be sited at optimal locations based on readily available information on mine plans, wind roses, ambient air boundaries and proximity to nearby residences. PMM will utilize a 5-year wind rose from the National Weather Service's (NWS) Lawrenceville, Illinois station located 25 miles southwest of Bear Run. This is the closest data set with the requisite quality and quantity of data and is representative of conditions expected at Bear Run. A five-year (2006 – 2010) wind rose is included along with four, five-year seasonal wind roses in Appendix B. (A wind rose is a useful way of displaying wind data to show the distribution of wind speeds and directions.)

In locating sites, four criteria may be considered in the site selection process depending on the sampling objective and include the following:

1. Impacts of known pollutant emission categories on air quality.
2. Population density relative to projected impact locations.
3. Impacts of known pollutant emission sources on air quality.
4. Representative area-wide air quality.

In selecting locations according to these criteria, it is desired *"to have detailed information on the location of emission sources, geographical variability of ambient pollutant concentrations, meteorological conditions and population density".* (see EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods, December 2008). The variability of sources, meteorological condition, and demographic features require that the selection of the

monitoring sites will be based upon uniquely site-specific information and on the experience of PMM's air quality consultant, MMA.

According to EPA's reference above, "*The sampling site selection process involves considerations of the following factors:*

Economics - The amount of resources required for the entire data collection activity, including operators, instrumentation, installation, safety equipment, maintenance, data retrieval/data transfer, data analysis, quality assurance and data interpretation.

Security - Experience has shown that in some cases, a particular site may not be appropriate for the establishment of an ambient monitoring station simply due to problems with the security of the equipment in a certain area. If the problems cannot be remedied via the use of standard security measures such as lighting, fences, etc., then attempts should be made to locate the site as near to the identified sector as possible while maintaining adequate security.

Logistics - Logistics is the process of dealing with the procurement, maintenance and transportation of material and personnel for a monitoring operation. This process requires the full knowledge of all aspects of the data collection operation including:

Planning
Reconnaissance
Training
Scheduling
Safety
Staffing
Procurement of goods and services
Communications
Inventory

Atmospheric considerations - Atmospheric considerations may include the spatial and temporal variability of the pollutants and its transport to the monitoring site. Effects of buildings, terrain, and heat sources or sinks on the air trajectories can produce local anomalies of excessive pollutant concentrations. Meteorology must be considered in determining not only the geographical location of a monitoring site but also such factors as height, direction, and extension of sampling probes. The following meteorological factors can greatly influence the dispersal of pollutants:

Wind speed affects the travel time from the pollutant source to the receptor and the dilution of polluted air in the downwind direction. The concentrations of air pollutants are inversely proportional to the wind speed.

Wind direction influences the general movements of pollutants in the atmosphere. Review of available data can indicate mean wind direction in the vicinity of the major sources of emissions.

Wind variability refers to the random motions in both horizontal and vertical velocity components of the wind. These random motions can be considered atmospheric turbulence, which is either mechanical (caused by structures and changes in terrain) or thermal (caused by heating and cooling of land masses or bodies of water). If the scale of turbulent motion is larger than the size of the pollutant plume, the turbulence will move the entire plume and cause looping and fanning; if smaller, it will cause the plume to diffuse and spread out.

If the meteorological phenomena impact with some regularity, data may need to be interpreted in light of these atmospheric conditions."

As stated above, available wind roses will be used to determine mean wind direction in the vicinity of the mine operation. MMA representatives will be scheduling an appropriate number of visits to Bear Run to complete the required assessments and ensure the proper siting of the monitors.

In summary, PMM will conduct the site selection process per the criteria and factors listed above. PMM will determine the locations of expected maximum PM_{10} emissions based on the current mine plan, paying special attention to mining/pit progressions, haul routes, stockpiles and other potential sources of PM_{10}. Using the wind roses described above, PMM will search for two suitable sites in predominant downwind directions from the source regions and one site in an area generally upwind of PM_{10} source regions. Suitability of the sites will also be dependent upon ready availability of line power, access and PMM's ability to negotiate arrangements with existing land owners.

Because mining operations generate surface-based emissions, maximum ground-level concentrations are always measured at the permit line (ambient air boundary) closest to mining activities. Optimum sites may not always have readily accessible line power or necessary access arrangements, so the selection of final sites will require some time to determine. Monitoring sites will be selected by March 16, 2012. Final siting rationale will be provided in the QAPP described in the following section. The QAPP will be submitted to EPA by April 13, 2012.

Installation of the sites will commence upon approval of the QAPP and monitoring site locations by the EPA. While EPA is reviewing the QAPP, PMM will work on obtaining permit and site access approvals, if needed, for the monitoring sites and arranging for installation of 110 VAC line power at each location. This process is expected to take anywhere from 4 to 8 weeks. Once all approvals are obtained and each site has power, the installation activities will commence. Installation of the monitoring sites and training of the site operator(s) is expected to take up to two weeks.

3.0 Quality Assurance Project Plan (QAPP)

The Quality Assurance Project Plan (QAPP) will be developed once monitoring sites and specific equipment models are selected. The QAPP will be submitted to EPA by April 13, 2012.

The QAPP will be formatted as per "Guidance for Quality Assurance Project Plans, EPA QA/G5", EPA/240/R-02/009, December 2002. The QAPP for the ambient PM_{10} and meteorological monitoring program will have four element groups: project management, data generation and acquisition, assessment and oversight, and data validation and usability.

The elements in the project management element group will consist of:

- Title and Approval Sheet: This element identifies key project officials and documents their approval of the QA Project Plan.
- Table of Contents: This element allows the reader to locate the different information sections.
- Distribution List: This element identifies all individuals who should get a copy of the approved QAPP.
- Project Organization: This element facilitates identifying the roles and responsibilities of those individuals involved in the project and their different organizations
- Project Definition and Background: This element describes why the project will be done and what needs to be done.
- Project/Task Description: This element describes the approach taken to address the project's objectives.

- Quality Objectives and Criteria for Measurement Data: This element describes quality specifications for the measurements used in the study.
- Special Training Requirements and Certifications: This element identifies any specialized training needed by project personnel working on the monitoring program.
- Documents and Records: This element includes information concerning the management of project documents and records.

The elements in the data generation and acquisition element group will consist of:

- Sampling Process: This element describes how the project's data collection will occur.
- Sampling and Reference Methods: This element details how samples or information will be collected consistently between locations and by all sampling personnel.
- Sample Handling and Custody: This element describes sample labeling, collection, and transportation.
- Analytical Methods: This element identifies the procedures to analyze samples.
- Quality Control: This section details the overall system of technical activities that measure the attributes and performance of the monitoring program.
- Instrument/Equipment Testing, Inspection, and Maintenance: This element describes how project personnel will know that the equipment is working properly.
- Instrument/Equipment Calibration and Frequency: This element identifies how the project will ensure continual quality performance of the monitoring instruments.
- Inspection/Acceptance of Supplies and Consumables: This element lists the critical field and laboratory supplies and consumables needed.
- Non-direct Measurements: This element addresses any data obtained from sources external to the project.
- Data Management: This element gives an overview of the management of the data generated throughout the project.

The elements in the assessment and oversight element group will consist of:

- Assessments and Response Actions: This element describes the evaluation process used during the project to ensure that the QA Project Plan is being implemented as approved.
- Reports to Management: This element lists the frequency, content, and distribution of project reports.

The elements in the data validation and usability element group will consist of:

- Data Review, Verification, and Validation: This element lists the criteria used to accept, reject, or qualify project data.
- Verification and Validation Methods: This element identifies process for verifying and validating project data.
- Reconciliation with User Requirements: This element discusses the final assessment of the data quality based on quality process used during the project.

Instrument Calibrations

Federal and state monitoring guidelines for quality control (QC) require that ambient particulate samplers and meteorological sensors be calibrated at certain times. Initial calibrations will be conducted immediately upon commencement of the project and at the mid-point of the 4-month monitoring program. After each set of calibrations is completed, a letter summarizing the results will be prepared and submitted to EPA within 21 days.

Quality Assurance/Performance Audits

Federal and state monitoring guidelines for quality assurance (QA) require that performance audits for particulate samplers and meteorological sensors be conducted at certain times during the monitoring program. A startup performance audit will be conducted within 15 days of monitoring start up, at the mid-point of the 4-month monitoring program and within 15 days of monitoring shutdown. Subsequent to each trip, a performance audit report will be prepared and submitted to EPA within 21 days of the completion of the audit.

Per federal requirements, performance audits will be completed by a different individual than the one who calibrates the instrumentation and using different test equipment than used to calibrate the monitoring instrumentation.

Certification of Calibration Standards; Certification Records

Test instrumentation used to calibrate and audit the particulate samplers and meteorological sensors will be certified yearly using standards traceable to the National

Institute of Standards & Technology (NIST), where possible. Originals of the certification documents will be kept in the office files of PMM's air monitoring contractor. Copies will be included in the performance audit reports and calibration results letters.

4.0 PM_{10} Sample Collection

Once installed, the ambient particulate samplers will be monitored for PM_{10} on a 24-hour integrated basis. These samplers will be volumetric-flow-controlled units operated midnight to midnight local standard time on a "one in three day" basis. Sample filters will be changed manually. The sampler inlet will be located in the breathing zone 2 to 7 meters above the ground, mounted on secured platforms. Instrumentation is listed in Table 1 and detailed specifications are provided in Appendix A.

5.0 Reporting

PMM will provide monthly, letter-type data reports to EPA by the 21st day of the following month. Sample filters will be shipped to a qualified laboratory on a two week basis. Quality assured concentration data will be expected from the laboratory within 14 days of receipt of samples from PMM.

Calibration and audit reports will also be submitted to EPA within 21 days of their conduct. As described in Section 3.0 above, calibrations and audits will be conducted every other month to ensure data quality.

6.0 Schedule of Deliverables

Following is a summary of key milestones for the project:

Selection of monitoring sites	March 16, 2012
Submittal of QAPP to EPA	April 13, 2012
Initiation of monitoring	June 1, 2012
Monthly data reports submitted to EPA	By 21st day of following month

Performance audit reports	Within 21 days of conduct
Calibration results	Within 21 days of conduct

Table 1: Proposed Monitoring Instrumentation

Measured Parameter	Manufacturer	Model	EPA Federal Reference Method (FRM)
PM_{10}	Tisch Environmental	TE-6070V	RFPS-0202-14
Wind Speed	RM Young	05305	NA
Wind Direction	RM Young	05305	NA
Ambient Temperature	RM Young	41342VC	NA
Rainfall	RM Young	55203	NA
Barometric Pressure	RM Young	61302	NA
Data Acquisition System	Campbell Scientific	CR1000	NA

Appendix A

Specifications of Proposed Monitoring Instrumentation

VFC-PM10

Manufacturer of Air Pollution Monitoring Equipment

TE-6070V

Volumetric Flow controlled (VFC) PM10 Monitor in Ambient Air

Volumetric Flow Controlled PM10 System includes:

- size selective inlet (<10 micron cut size)
- anodized aluminum shelter
- 8" x 10" stainless steel filter holder with stagnation pressure tap
- blower motor assembly
- continuous flow/pressure recorder
- elapsed time indicator
- 30" water manometer
- volumetric flow controller with look-up table
- filter media holder/filter paper cartridge (8" x 10")
- 7-day mechanical timer
- 110v/60hz or 220v/50hz

Reference Method RFPS-0202-141

Specifications

Flow rate:	40 cfm (1.13m^3) continuous
Filter media:	Micro-quartz filter media 8" x 10" for PM10 (TE-QMA)
Flow control:	VFC (TE-10557PM10)
Motor blower:	2-stage motor 1.0 hp 110v/60hz (TE-115923)
Water manometer:	30" water manometer (TE-5030)
Flow indicator:	Flow/pressure recorder (TE-5009) with charts (TE-106)
Timer:	7-day mechanical timer (TE-5007)
Elapsed time indicator device:	Elapsed time indicator (TE-5012)

Shipping information **(three cartons)**

Size/weight:	45.5" x 22.5" x 20"/50 lbs 32" x 32" x 25.5"/56 lbs 28" x 21" x 10"/19 lbs
Motor specifications:	110v/60hz—Part TE-115923 double ball bearing, thru-flow discharge 220v/50hz—Part TE-116111 ball/sleeve bearing thru-flow discharge Sample delay: 0–7 Days Start up amps: 20 Amps Running amps: 7 Amps

TE-6070DV

Volumetric Flow controlled (VFC) PM10 Monitor in Ambient Air

Same as TE-6070V except:

Timer:	Solid state digital timer programmer with digital elapsed time indicator (TE-302)

Tisch Environmental, Inc. 145 South Miami Ave. Village of Cleves OH 45002 USA
Phone 513.467.9000 Toll Free 877.263.7610 Fax 513.467.9009 Website www.tisch-env.com

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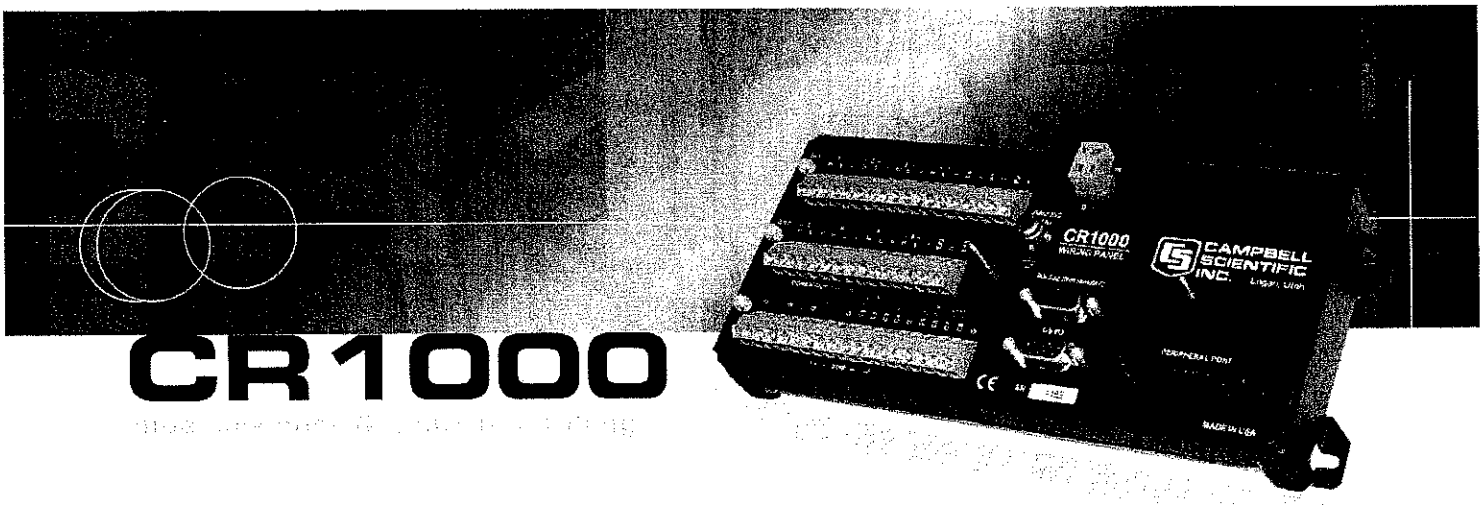
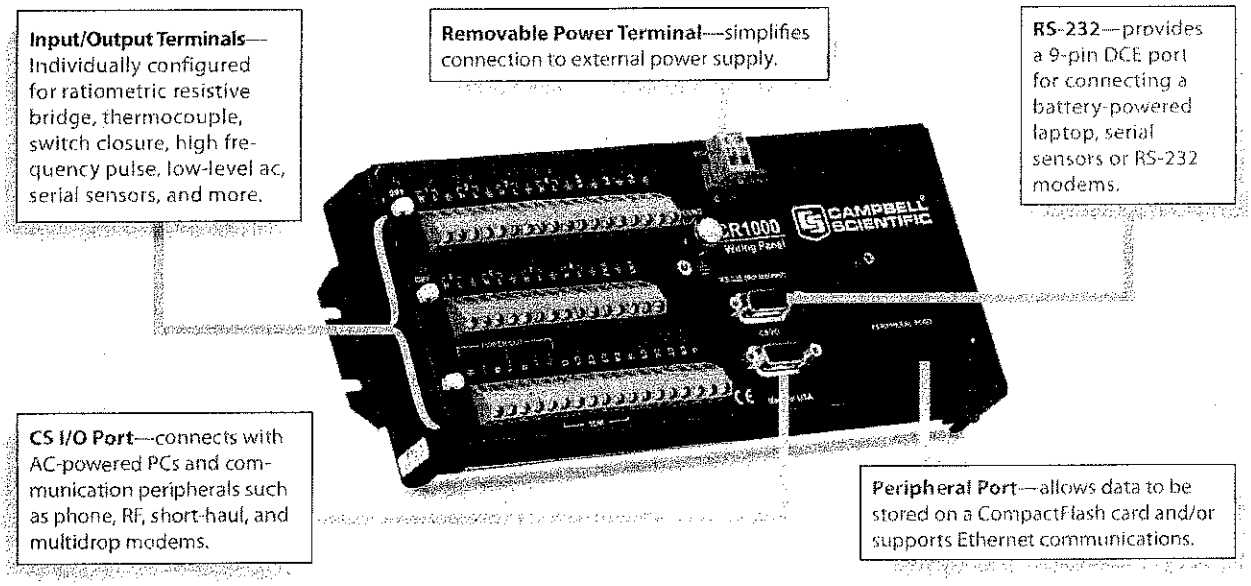


CR1000

CR1000 Measurement and Control System

The CR1000 provides precision measurement capabilities in a rugged, battery-operated package. It consists of a measurement and control module and a wiring panel. Standard operating range is -25° to +50°C; an optional extended range of -55° to +85°C is available.



Features

- 4 Mbyte memory*
- Program execution rate of up to 100 Hz
- CS I/O and RS-232 serial ports
- 13-bit analog to digital conversions
- 16-bit H8S Renesas Microcontroller with 32-bit internal CPU architecture
- Temperature compensated real-time clock
- Background system calibration for accurate measurements over time and temperature changes
- Single DAC used for excitation and measurements to give ratio metric measurements
- Gas Discharge Tube (GDT) protected inputs
- Data values stored in tables with a time stamp and record number
- Battery-backed SRAM memory and clock ensuring data, programs, and accurate time are maintained while the CR1000 is disconnected from its main power source
- Serial communications with serial sensors and devices supported via I/O port pairs
- PakBus®, Modbus, DNP3, TCP/IP, FTP, and SMTP protocols supported

Measurement and Control Module

The module measures sensors, drives direct communications and telecommunications, reduces data, controls external devices, and stores data and programs in on-board, non-volatile storage. The electronics are RF shielded and glitch protected by the sealed, stainless steel canister. A battery-backed clock assures accurate timekeeping. The module can simultaneously provide measurement and communication functions. The on-board, BASIC-like programming language supports data processing and analysis routines.

Wiring Panel

The CR1000WP is a black, anodized aluminum wiring panel that is compatible with all CR1000 modules. The wiring panel includes switchable 12 V, redistributed analog grounds (dispersed among analog channels rather than grouped), unpluggable terminal block for 12 V connections, gas-tube spark gaps, and 12 V supply on pin 8 to power our COM-series phone modems and other peripherals. The control module easily disconnects from the wiring panel allowing field replacement without rewiring the sensors. A description of the wiring panel's input/output channels follows.

**Originally, the standard CR1000 had 2 MB of data/program storage, and an optional version, the CR1000-4M, had 4 MB of memory. In September 2007, the standard CR1000 started having 4 MB of memory, making the CR1000-4M obsolete. Dataloggers that have a module with a serial number greater than or equal to 11832 will have a 4 MB memory. The 4 MB dataloggers will also have a sticker on the canister stating "4M Memory".*

Analog Inputs
Eight differential (16 single-ended) channels measure voltage levels. Resolution on the most sensitive range is 0.67 µV.

Pulse Counters
Two pulse channels can count pulses from high level (5 V square wave), switch closure, or low level AC signals.

Switched Voltage Excitations
Three outputs provide precision excitation voltages for resistive bridge measurements.

Digital I/O Ports
Eight ports are provided for frequency measurements, digital control, and triggering. Three of these ports can also be used to measure SDM devices. The I/O ports can be paired as transmit and receive. Each pair has 0 to 5 V UART hardware that allows serial communications with serial sensors and devices. An RS232-to-logic level converter may be required in some cases.

CS I/O Port
AC-powered PCs and many communication peripherals connect with the CR1000 via this port. Connection to an AC-powered PC requires either an SC32B or SC-USB interface. These interfaces isolate the PC's electrical system from the datalogger, thereby protecting against ground loops, normal static discharge, and noise.

RS-232 Port
This non-isolated port is for connecting a battery-powered laptop, serial sensor, or RS-232 modem. Because of ground loop potential on some measurements (e.g., low level single-ended measurements), AC-powered PCs should use the CS I/O port instead of the RS-232 port (see above).

Peripheral Port
One 40-pin port interfaces with the NL115 Ethernet Interface & CompactFlash Module, the NL120 Ethernet Interface, or the CFM100 CompactFlash® Module.

Switched 12 Volt
This terminal provides unregulated 12 V that can be switched on and off under program control.

Storage Capacity
The CR1000 has 2 MB of flash memory for the Operating System, and 4 MB of battery-backed SRAM for CPU usage, program storage, and data storage. Data is stored in a table format. The storage capacity of the CR1000 can be increased by using a CompactFlash card.

Communication Protocols
The CR1000 supports the PakBus, Modbus, DNP3, TCP/IP, FTP, and SMTP communication protocols. With the PakBus protocol, networks have the distributed routing intelligence to continually evaluate links. Continually evaluating links optimizes delivery times and, in the case of delivery failure, allows automatic switch over to a configured backup route.

The Modbus RTU protocol supports both floating point and long formats. The datalogger can act as a slave and/or master.

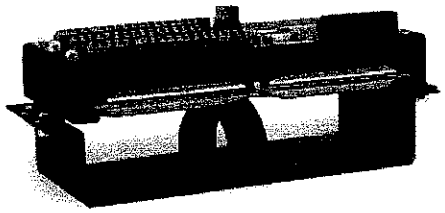
The DNP3 protocol supports only long data formats. The dataloggers are level 2 slave compliant, with some of the operations found in a level 3 implementation.

The TCP/IP, FTP, and SMTP protocols provide TCP/IP functionality when the CR1000 is used in conjunction with an NL115, NL120, or third party serial IP device. Refer to the CR1000 manual for more information.

Power Supplies
Any 12 Vdc source can power the CR1000; a PS100 or BPALK is typically used. The PS100 provides a 7-Ahr sealed rechargeable battery that should be connected to a charging source (either a wall charger or solar panel). The BPALK consists of eight non-rechargeable D-cell alkaline batteries with a 7.5-Ahr rating at 20°C.

Also available are the BP12 and BP24 battery packs, which provide nominal ratings of 12 and 24 Ahrs, respectively. These batteries should be connected to a regulated charging source (e.g., a CH100 connected to a unregulated solar panel or wall charger).

Enclosure/Stack Bracket
A CR1000 housed in a weather-resistant enclosure can collect data under extremely harsh conditions. The 17565 Stack Bracket allows a small peripheral to be placed under the mounting bracket, thus conserving space. With the bracket, the CR1000 can be attached in a "horizontal" orientation in an ENC10/12 enclosure (i.e., the long axis of the CR1000 spanning the short axis of the enclosure).



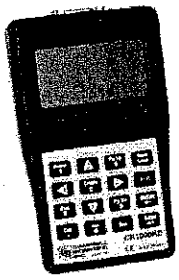
Above is a CR1000 mounted to the stack bracket. The Velcro strap is for fastening a peripheral to the base of the bracket.

Data Storage and Retrieval Options

To determine the best option for an application, consider the accessibility of the site, availability of services (e.g., cellular phone or satellite coverage), quantity of data to collect, and desired time between data-collection sessions. Some communication options can be combined—increasing the flexibility, convenience, and reliability of the communications.

Keyboard Display

The CR1000KD can be used to program the CR1000, manually initiate data transfer, and display data. The CR1000KD displays 8 lines x 21 characters (64 x 128 pixels) and has a 16-character keyboard. Custom menus are supported allowing customers to set up choices within the datalogger program that can be initiated by a simple "toggle" or "pick list".



One CR1000KD can be carried from station to station in a CR1000 network.

Portable Handheld Devices

An Archer-PCon or user-supplied PDA can be used to collect and display the CR1000's data, transfer datalogger programs, graph data for up to two elements, and transfer the datalogger's data to a PC. User-supplied PDAs require either PConnect or PConnectCE software.

Direct Links

AC-powered PCs connect with the datalogger's CS I/O port via an SC32B or SC-USB interface. These interfaces provide optical isolation. A battery-powered laptop can be attached to the CR1000's RS-232 port via an RS-232 cable—no interface required.

External Data Storage Devices

A CFM100 or NL115 module can store the CR1000's data on an industrial-grade CompactFlash (CF) card (2 GB or less). The PC reads the CF card using either the CF1 CompactFlash Adapter or a 17752 USB Reader/Writer. The CR1000 can also store data on an SC115 2-GB Flash Memory Drive.

Mountable Displays

The CD100 and CD295 can be mounted in an enclosure lid. The CD100 has the same functionality and operation as the CD1000KD, allowing both data entry and display without opening the enclosure. The CD295 displays real-time data only.

Short Haul Modems

The SRM-5A RAD Short Haul Modem supports communications between the CR1000 and a PC via a four-wire unconditioned line (two twisted pairs).

Multidrop Interface

The MD485 intelligent RS-485 interface permits a PC to address and communicate with one or more dataloggers over the CABLE2TP two-twisted pair cable. Distances up to 4000 feet are supported.

Ethernet

Use of an NL200, NL120, NL115, or NL100 interface enables the CR1000 to communicate over a local network or a dedicated Internet connection via TCP/IP. The NL115 can also store data on a CompactFlash card.

Radios

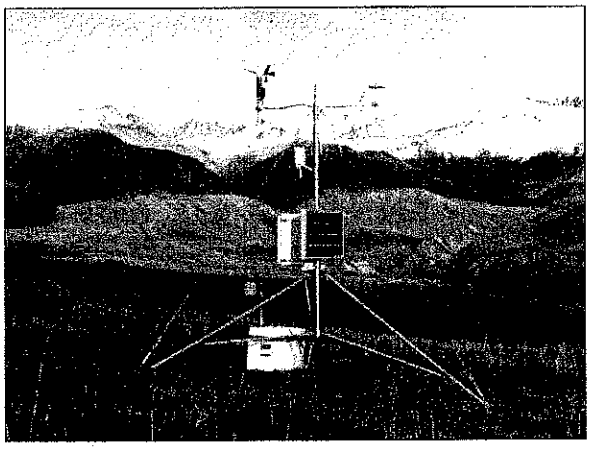
Radio frequency (RF) communications are supported via narrow-band UHF, narrow-band VHF, spread spectrum, or meteor burst radios. Line-of-sight is required for all of our RF options.

Telephone Networks

The CR1000 can communicate with a PC using landlines, cellular CDMA, or cellular GPRS transceivers. A voice synthesized modem enables anyone to call the CR1000 via phone and receive a verbal report of real-time site conditions.

Satellite Transmitters

Our NESDIS-certified GOES satellite transmitter provides one-way communications from a Data Collection Platform (DCP) to a receiving station. We also offer an Argos transmitter that is ideal for high-altitude and polar applications.



This weather station at Denali National Park, Alaska, transmits data via a GOES satellite transmitter.

Channel Expansion

4-Channel Low Level AC Module

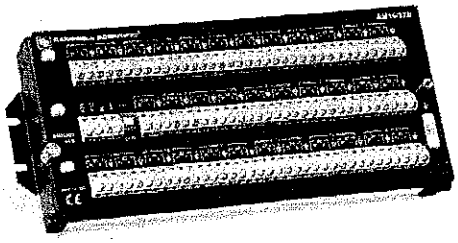
The LLAC4 is a small peripheral device that allows customers to increase the number of available low-level ac inputs by using control ports. This module is often used to measure up to four anemometers, and is especially useful for wind profiling applications.

Synchronous Devices for Measurement (SDMs)

SDMs are addressable peripherals that expand the datalogger's measurement and control capabilities. For example, SDMs are available to add control ports, analog outputs, pulse count channels, interval timers, or even a CANbus interface to the system. Multiple SDMs, in any combination, can be connected to one datalogger.

Multiplexers

Multiplexers increase the number of sensors that can be measured by a CR1000 by sequentially connecting each sensor to the datalogger. Several multiplexers can be controlled by a single CR1000.



The CR1000 is compatible with the AM16/32B (shown above) and AM25T multiplexers.

Software

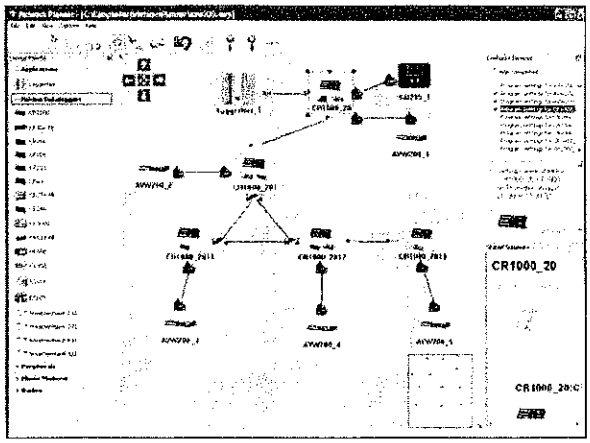
Starter Software

Our easy-to-use starter software is intended for first time users or applications that don't require sophisticated communications or datalogger program editing. SCWin Short Cut generates straight-forward CR1000 programs in four easy steps. PC200W allows customers to transfer a program to, or retrieve data from a CR1000 via a direct communications link.

At www.campbellsci.com/downloads you can download starter software at no charge. Our Resource CD also provides this software as well as PDF versions of our brochures and manuals.

Datalogger Support Software

Our datalogger support software packages provide more capabilities than our starter software. These software packages contains program editing, communications, and display tools that can support an entire datalogger network.

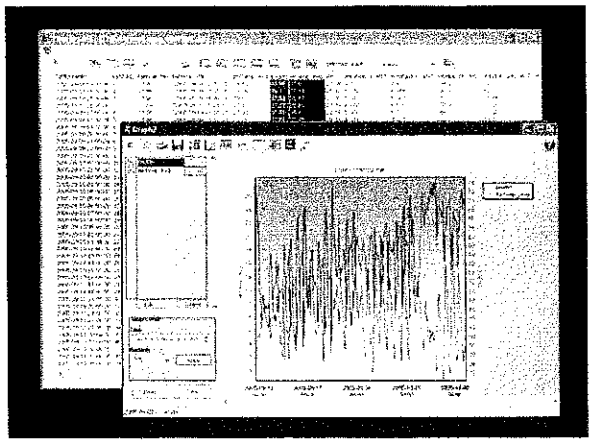


The Network Planner, included in LoggerNet 4 or higher, generates device settings and configures the LoggerNet network map for PakBus networks.

PC400, our mid-level software, supports a variety of telemetry options, manual data collection, and data display. For programming, it includes both Short Cut and the CRBasic program editor. PC400 does not support combined communication options (e.g., phone-to-RF), PakBus® routing, or scheduled data collection.

RTDAQ is an ideal solution for industrial and real-time users desiring to use reliable data collection software over a single telecommunications medium, and who do not rely on scheduled data collection. RTDAQ's strength lies in its ability to handle the display of high speed data.

LoggerNet is Campbell Scientific's full-featured datalogger support software. It is referred to as "full-featured" because it provides a way to accomplish almost all the tasks you'll need to complete when using a datalogger. LoggerNet supports combined communication options (e.g., phone-to-RF) and scheduled data collection.



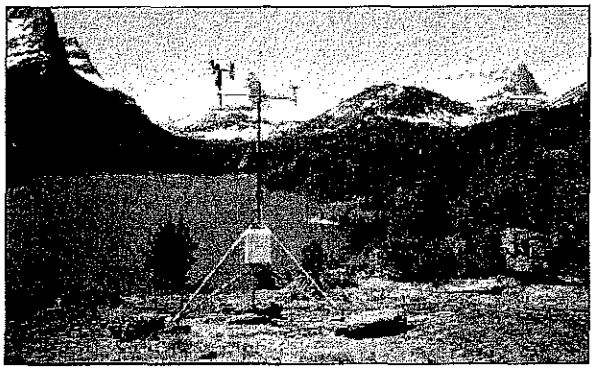
Both LoggerNet and RTDAQ use View Pro to display historical data in a tabular or graphical format.

Applications

The measurement precision, flexibility, long-term reliability, and economical price of the CR1000 make it ideal for scientific, commercial, and industrial applications.

Meteorology

The CR1000 is used in long-term climatological monitoring, meteorological research, and routine weather measurement applications.



Our rugged, reliable weather station measures meteorological conditions at St. Mary's Lake, Glacier National Park, MT.

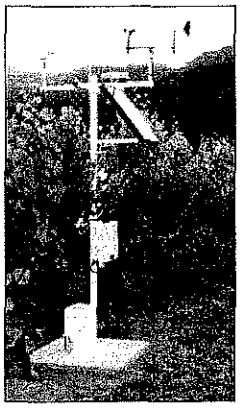
Sensors the CR1000 can measure include:

- cup, propeller, and sonic anemometers
- tipping bucket rain gages
- wind vanes
- pyranometers
- ultrasonic ranging sensor
- thermistors, RTDs, and thermocouples
- barometric pressure sensors
- RH sensors
- cooled mirror hygrometers

Agriculture and Agricultural Research

The versatility of the CR1000 allows measurement of agricultural processes and equipment in applications such as:

- plant water research
- canopy energy balance
- machinery performance
- plant pathology
- crop management decisions
- food processing/storage
- frost prediction
- irrigation scheduling
- integrated pest management



This vitaculture site in Australia integrates meteorological, soil, and crop measurements.

Wind Profiling

Our data acquisition systems can monitor conditions at wind assessment sites, at producing wind farms, and along transmission lines. The CR1000 makes and records measurements, controls electrical devices, and can function as PLCs or RTUs. Because the datalogger has its own power supply (batteries, solar panels), it can continue to measure and store data and perform control during power outages.

Typical sensors for wind assessment applications include, but are not limited to:

- sonic anemometers
- three-cup and propeller anemometers (up to 10 anemometers can be measured by using two LLAC4 peripherals)
- wind vanes
- temperature sensors
- barometric pressure
- wetness
- solar radiation

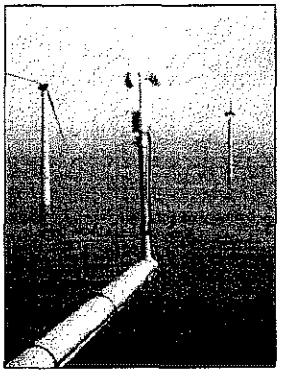


Photo courtesy npower renewables

A Campbell Scientific system monitors an offshore wind farm in North Wales.

For turbine performance applications, the CR1000 monitors electrical current, voltage, wattage, stress, and torque.

Soil Moisture

The CR1000 is compatible with the following soil moisture measurement technologies:

- Soil moisture blocks are inexpensive sensors that estimate soil water potential.
- Matric water potential sensors also estimate soil water potential but are more durable than soil moisture blocks.
- Time-Domain Reflectometry Systems (TDR) use a reflectometer controlled by a CR1000 to accurately measure soil water content. Multiplexers allow sequential measurement of a large number of probes by one reflectometer, reducing cost per measurement.
- Self-contained water content reflectometers are sensors that emit and measure a TDR pulse.
- Tensiometers measure the soil pore pressure of irrigated soils and calculate soil moisture.

Air Quality

The CR1000 can monitor and control gas analyzers, particle samplers, and visibility sensors. It can also automatically control calibration sequences and compute conditional averages that exclude invalid data (e.g., data recorded during power failures or calibration intervals).

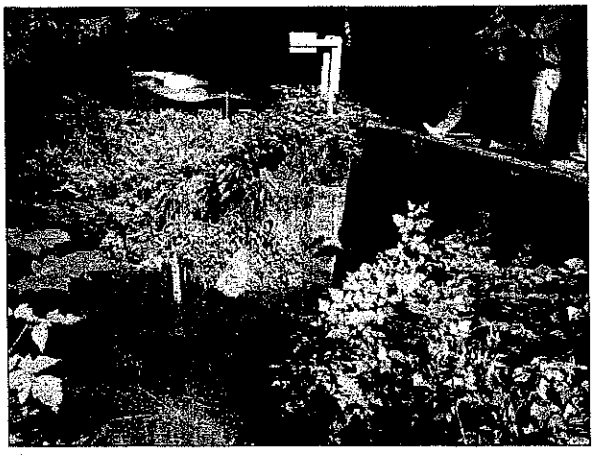
Road Weather/RWIS

Our fully NTCIP-compliant Environmental Sensor Stations (ESS) are robust, reliable weather stations used for road weather/RWIS applications. A typical ESS includes a tower, CR1000, two road sensors, remote communication hardware, and sensors that measure wind speed and direction, air temperature, humidity, barometric pressure, solar radiation, and precipitation.

Water Resources/Aquaculture

Our CR1000 is well-suited to remote, unattended monitoring of hydrologic conditions. Most hydrologic sensors, including SDI-12 probes, interface directly to the CR1000. Typical hydrologic measurements:

- **Water level** is monitored with incremental shaft encoders, double bubblers, ultrasonic ranging sensors, resistance tapes, strain gage pressure transducers, or vibrating wire pressure transducers. Vibrating wire transducers require an AVW200-series or another vibrating wire interface.
- **Ionic conductivity** measurements use one of the switched excitation ports from the CR1000.
- **Samplers** are controlled by the CR1000 as a function of time, water quality, or water level.
- **Alarm and pump actuation** are controlled through digital I/O ports that operate external relay drivers.



A turbidity sensor was installed in a tributary of the Cedar River watershed to monitor water quality conditions for the city of Seattle, Washington.

Vehicle Testing

This versatile, rugged datalogger is ideally suited for testing cold and hot temperature, high altitude, off-highway, and cross-country performance. The CR1000 is compatible with our SDM-CAN interface and GPS16X-HVS receiver.

Vehicle monitoring includes not only passenger cars, but airplanes, locomotives, helicopters, tractors, buses, heavy trucks, drilling rigs, race cars, and motorcycles.

The CR1000 can measure:

- **Suspension**—strut pressure, spring force, travel, mounting point stress, deflection, ride
- **Fuel system**—line and tank pressure, flow, temperature, injection timing
- **Comfort control**— fan speed, ambient and supply air temperature, refrigerant pressures, solar radiation, ac on and off, time-to-comfort, blower current
- **Brakes**—line pressure, pedal pressure and travel, ABS, line and pad temperature
- **Engine**—pressure, temperature, crank position, RPM, time-to-start, oil pump cavitation
- **General vehicle**—chassis monitoring, road noise, vehicle position and speed, steering, air bag, hot/cold soaks, wind tunnels, traction, CANbus, wiper speed and current, vehicle electrical loads

Other Applications

- Eddy covariance systems
- Wireless sensor/datalogger networks
- Mesonet systems
- Avalanche forecasting, snow science, polar, high altitude
- Fire weather
- Geotechnical
- Historic preservation

CR1000 Specifications

Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, Campbell Scientific recommends recalibrating dataloggers every two years. We recommend that the system configuration and critical specifications are confirmed with Campbell Scientific before purchase.

PROGRAM EXECUTION RATE

10 ms to one day @ 10 ms increments

ANALOG INPUTS (SE1-SE16 or DIFF1-DIFF8)

8 differential (DF) or 16 single-ended (SE) individually configured. Channel expansion provided by AM16/32B and AM25T multiplexers.

RANGES and RESOLUTION: Basic resolution (Basic Res) is the A/D resolution of a single conversion. Resolution of DF measurements with input reversal is half the Basic Res.

Range (mV)[1]	DF Res (µV)[2]	Basic Res (µV)
±5000	667	1333
±2500	333	667
±250	33.3	66.7
±25	3.33	6.7
±7.5	1.0	2.0
±2.5	0.33	0.67

[1]Range overhead of ~9% on all ranges guarantees that full-scale values will not cause over range.

[2]Resolution of DF measurements with input reversal.

ACCURACY[3]:
±(0.06% of reading + offset), 0° to 40°C
±(0.12% of reading + offset), -25° to 50°C
±(0.18% of reading + offset), -55° to 85°C (-XT only)

[3]Accuracy does not include the sensor and measurement noise. The offsets are defined as:
Offset for DF w/input reversal = 1.5-Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3-Basic Res + 2.0 µV
Offset for SE = 3-Basic Res + 3.0 µV

INPUT NOISE VOLTAGE: For DF measurements with input reversal on ±2.5 mV input range; digital resolution dominates for higher ranges.

250 µs Integration: 0.34 µV RMS
50/60 Hz Integration: 0.19 µV RMS

ANALOG MEASUREMENT SPEED:

Integration Type/ Code	Integration Time	Settling Time	Total Time[5] SE w/ No Rev	Total Time[5] DF w/ Input Rev
250	250 µs	450 µs	~1 ms	~12 ms
60 Hz[4]	16.67 ms	3 ms	~20 ms	~40 ms
50 Hz[4]	20.00 ms	3 ms	~25 ms	~50 ms

[4]AC line noise filter.

[5]Includes 250 µs for conversion to engineering units.

INPUT LIMITS: ±5 V

DC COMMON MODE REJECTION: >100 dB

NORMAL MODE REJECTION: 70 dB @ 60 Hz when using 60 Hz rejection

SUSTAINED INPUT VOLTAGE W/O DAMAGE: ±16 Vdc max.

INPUT CURRENT: ±1 nA typical, ±6 nA max. @ 50°C; ±90 nA @ 85°C

INPUT RESISTANCE: 20 Gohms typical

ACCURACY OF BUILT-IN REFERENCE JUNCTION THERMISTOR (for thermocouple measurements):
±0.3°C, -25° to 50°C
±0.8°C, -55° to 85°C (-XT only)

ANALOG OUTPUTS (Vx1-Vx3)

3 switched voltage, active only during measurement, one at a time.

RANGE AND RESOLUTION: Voltage outputs programmable between ±2.5 V with 0.67 mV resolution.

V_x ACCURACY: ±(0.06% of setting + 0.8 mV), 0° to 40°C
±(0.12% of setting + 0.8 mV), -25° to 50°C
±(0.18% of setting + 0.8 mV), -55° to 85°C (-XT only)

V_x FREQUENCY SWEEP FUNCTION: Switched outputs provide a programmable swept frequency, 0 to 2500 mv square waves for exciting vibrating wire transducers.

CURRENT SOURCING/SINKING: ±25 mA

RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR1000 provides ratiometric measurements of 4- and 6-wire full bridges, and 2-, 3-, and 4-wire half bridges. Precise, dual polarity excitation using any of the 3 switched voltage excitations eliminates dc errors.

VOLTAGE RATIO ACCURACY[6]: Assuming excitation voltage of at least 1000 mV, not including bridge resistor error.

±{0.04% of voltage reading + offset)/V_x

[6]Accuracy does not include the sensor and measurement noise. The offsets are defined as:
Offset for DF w/input reversal = 1.5-Basic Res + 1.0 µV
Offset for DF w/o input reversal = 3-Basic Res + 2.0 µV
Offset for SE = 3-Basic Res + 3.0 µV

Offset values are reduced by a factor of 2 when excitation reversal is used.

PERIOD AVERAGE

Any of the16 SE analog inputs can be used for period averaging. Accuracy is ±(0.01% of reading + resolution), where resolution is 136 ns divided by the specified number of cycles to be measured.

INPUT AMPLITUDE AND FREQUENCY:

Voltage Gain	Input Range (±mV)	Signal (peak to peak)[7] Min. (mV)	Signal (peak to peak)[7] Max (V)	Min Pulse Width (µV)	Max[8] Freq (kHz)
1	2500	500	10	2.5	200
10	250	10	2	10	50
33	25	5	2	62	8
100	2.5	2	2	100	5

[7]With signal centered at the datalogger ground.

[8]The maximum frequency = 1/(Twice Minimum Pulse Width) for 50% of duty cycle signals.

PULSE COUNTERS (P1-P2)

(2) inputs individually selectable for switch closure, high frequency pulse, or low-level ac. Independent 24-bit counters for each input.

MAXIMUM COUNTS PER SCAN: 16.7×10^6

SWITCH CLOSURE MODE:
Minimum Switch Closed Time: 5 ms
Minimum Switch Open Time: 6 ms
Max. Bounce Time: 1 ms open w/o being counted

HIGH-FREQUENCY PULSE MODE:
Maximum Input Frequency: 250 kHz
Maximum Input Voltage: ±20 V
Voltage Thresholds: Count upon transition from below 0.9 V to above 2.2 V after input filter with 1.2 µs time constant.

LOW-LEVEL AC MODE: Internal AC coupling removes AC offsets up to ±0.5 V.
Input Hysteresis: 12 mV @ 1 Hz
Maximum ac Input Voltage: ±20 V
Minimum ac Input Voltage:

Sine Wave (mV RMS)	Range(Hz)
20	1.0 to 20
200	0.5 to 200
2000	0.3 to 10,000
5000	0.3 to 20,000

DIGITAL I/O PORTS (C1-C8)

8 ports software selectable, as binary inputs or control outputs. Also provide edge timing, subroutine interrupts/wake up, switch closure pulse counting, high frequency pulse counting, asynchronous communications (UART), SDI-12 communications, and SDM communications.

HIGH-FREQUENCY MAX: 400 kHz

SWITCH CLOSURE FREQUENCY MAX: 150 Hz

EDGE TIMING RESOLUTION: 540 ns

OUTPUT VOLTAGES (no load): high 5.0 V ±0.1 V; low <0.1

OUTPUT RESISTANCE: 330 ohms

INPUT STATE: high 3.8 to 16 V; low -6.0 to 1.2 V

INPUT HYSTERESIS: 1.4 V

INPUT RESISTANCE: 100 kohms

SWITCHED 12 V (SW-12)

One independent 12 V unregulated sources switched on and off under program control. Thermal fuse hold current = 900 mA @ 20°C, 650 mA @ 50°C, 360 mA @ 85°C.

CE COMPLIANCE

STANDARD(S) TO WHICH CONFORMITY IS DECLARED: IEC61326:2002

COMMUNICATIONS

RS-232 PORTS:
9-pin: DCE port for battery-powered computer or non-CSI modem connection.
COM1 to COM4: Four independent Tx/Rx pairs on control ports (non-isolated); 0 to 5 VUART
Baud Rates: selectable from 300 bps to 115.2 kbps.
Default Format: 8 data bits; 1 stop bits; no parity
Optional Formats: 7 data bits; 2 stop bits; odd, even parity

CS I/O PORT: Interface with CSI peripherals

SDI-12: Digital control ports 1, 3, 5, and 7 are individually configured and meet SDI-12 Standard version 1.3 for datalogger mode. Up to ten SDI-12 sensors are supported per port.

PERIPHERAL PORT: 40-pin interface for attaching CompactFlash or Ethernet peripherals

PROTOCOLS SUPPORTED: PakBus, Modbus, DNP3, FTP, HTTP, XML, POP3, SMTP, Telnet, NTCIP, NTP, SDI-12, SDM

CPU AND INTERFACE

PROCESSOR: Renesas H8S 2322 (16-bit CPU with 32-bit internal core)

MEMORY: 2 MB of Flash for operating system; 4 MB of battery-backed SRAM for CPU usage, program storage and data storage.

CLOCK ACCURACY: ±3 min. per year. Correction via GPS optional.

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc (reverse polarity protected)

EXTERNAL BATTERIES: 12 Vdc nominal

TYPICAL CURRENT DRAIN:
Sleep Mode: 0.7 mA (0.9 mA max.)
1 Hz Sample Rate (1 fast SE meas.): 1 mA
100 Hz Sample Rate (1 fast SE meas.): 16.2 mA
100 Hz Sample Rate (1 fast SE meas. w/RS-232 communication): 27.6 mA
Optional Keyboard Display On (no backlight): add 7 mA to current drain
Optional Keyboard Display On (backlight on): add 100 mA to current drain

PHYSICAL

DIMENSIONS: 9.4" x 4" x 2.4" (23.9 x 10.2 x 6.1 cm); additional clearance required for serial cable and sensor leads.

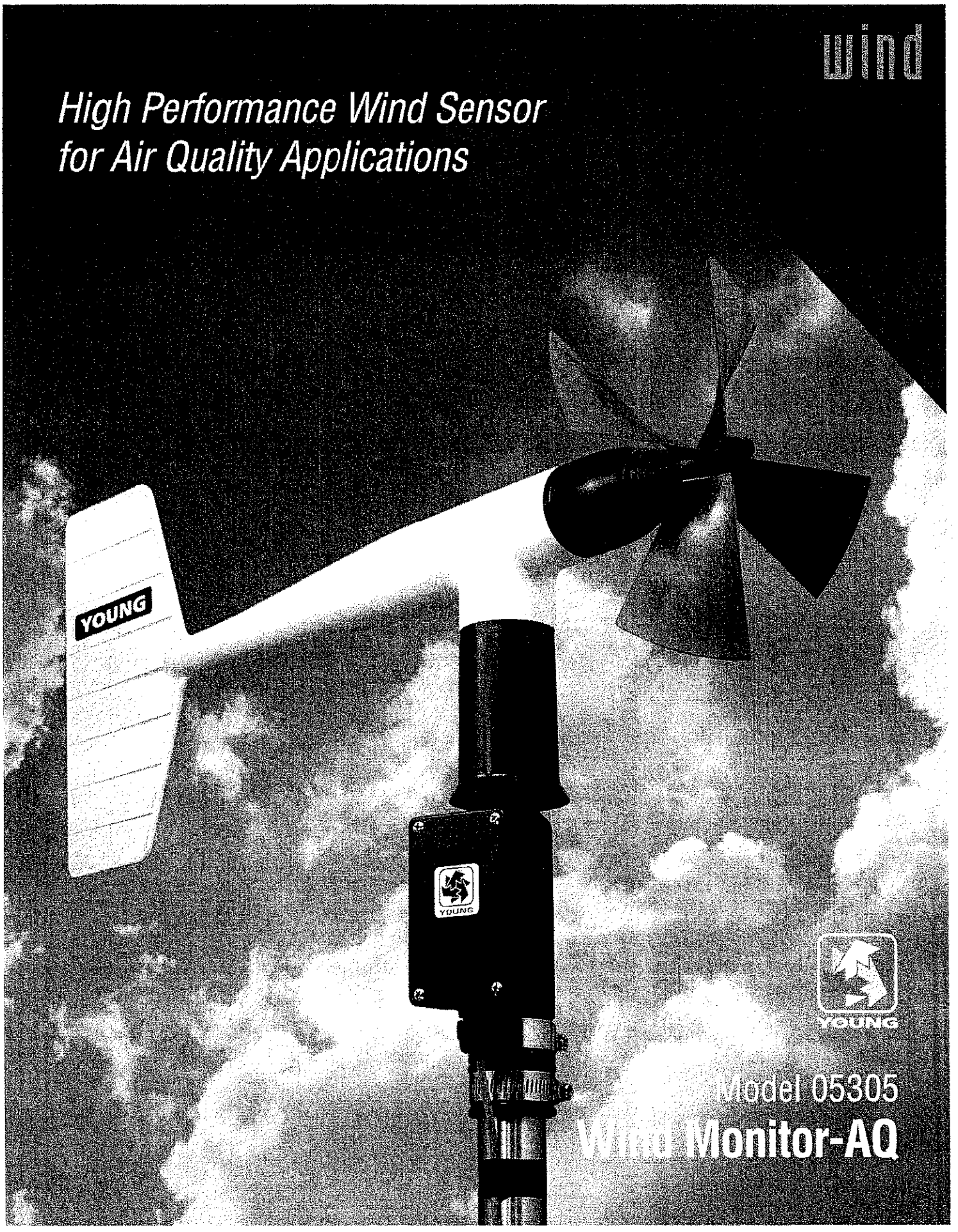
WEIGHT: 2.1 lbs (1 kg)

WARRANTY

3-years against defects in materials and workmanship.

wind

High Performance Wind Sensor for Air Quality Applications



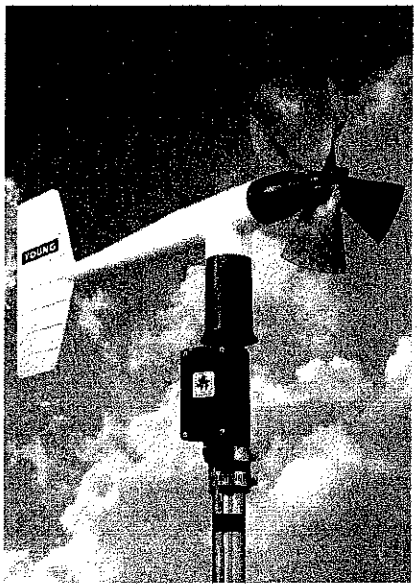
Model 05305

Wind Monitor-AQ

YOUNG

Model 05305 Wind Monitor-AQ

The Wind Monitor-AQ is a high resolution wind sensor designed specifically for air quality applications. It combines simple, corrosion-resistant construction with low threshhold, fast response and excellent fidelity.



The Wind Monitor-AQ meets the requirements of the following regulatory agencies:

U.S. Environmental Protection Agency – Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD).

U.S. Nuclear Regulatory Agency – NRC Regulatory Guide 1.23 Meteorological Programs in Support of Nuclear Power Plants.

American Nuclear Society – Standard for Determining Meteorological Information at Power Plants.

Wind speed is sensed by a lightweight, carbon fiber thermoplastic (CFT), helicoid propeller. Propeller rotation produces an AC sine wave voltage signal with frequency directly proportional to wind speed. Slip rings and brushes are not used.

The wind direction sensor is a lightweight vane with performance characteristics that assure excellent fidelity in fluctuating wind conditions. Vane position is sensed by a precision potentiometer. Dutput is a DC voltage directly proportional to vane angle.

The instrument body is UV stabilized plastic with stainless steel and anodized aluminum fittings. Precision grade, stainless steel ball bearings are used throughout. Transient protection and cable terminations are located in a convenient junction box. The instrument mounts on standard 1 inch pipe.

The Wind Monitor-AQ is available with two additional output signal options. **Model 05305V** offers calibrated voltage outputs, convenient for use with many dataloggers. **Model 05305L** provides a calibrated 4-20 mA current signal for each channel, useful in high noise areas or for long cables (up to several kilometers). Signal conditioning electronics are integrated into the sensor junction box.

Ordering Information — MODEL

WIND MONITOR-AQ	**05305**
WIND MONITOR-AQ VOLTAGE OUTPUTS	**05305V**
WIND MONITOR-AQ 4-20mA OUTPUTS	**05305L**

Specifications

Range:
Wind speed: 0-50 m/s (112 mph)
Azimuth: 360° mechanical, 355° electrical (5° open)

Accuracy:
Wind speed: ±0.2 m/s (0.4 mph) or 1% of reading
Wind direction: ±3 degrees

Threshold:*
Propeller: 0.4 m/s (.9 mph)
Vane: 0.5 m/s (1.0 mph) at 10° displacement

Dynamic Response:*
Propeller distance constant (63% recovery) 2.1 m (6.9 ft)
Vane delay distance (50% recovery) 1.2 m (3.9 ft)
Damping ratio: 0.45
Damped natural wavelength: 4.9 m (16.1 ft)
Undamped natural wavelength: 4.4 m (14.4 ft)

Signal Output:
Wind speed: magnetically induced AC voltage, 3 pulses per revolution, 1800 rpm (90 Hz) = 9.2 m/s (20.6 mph)
Azimuth: analog DC voltage from conductive plastic potentiometer – resistance 10K Ω, linearity 0.25%, life expectancy – 50 million revolutions

Power Requirement:
Potentiometer excitation: 15 VDC maximum

Dimensions:
Overall height: 38 cm (15.0 in)
Overall length: 65 cm (25.6 in)
Propeller: 20 cm (7.9 in) diameter
Mounting: 34 mm (1.34 in) diameter (standard 1 inch pipe)

Weight:
Sensor weight: 0.7 kg (1.5 lbs)
Shipping weight: 2.3 kg (5 lbs)

**Nominal values, determined in accordance with ASTM standard procedures. Shielded bearings lubricated with Type LO-1 light General Purpose Instrument Oil.*

MODEL 05305V Voltage outputs

Power Requirement:
8-24 VDC (5 mA @ 12 VDC)

Operating Temperature:
-50 to 50° C

Output Signals:
WS: 0-2.5 VDC (0-50 m/s)
WD: 0-5 VDC (0-360°)

MODEL 05305L 4-20 mA outputs

Power Requirement:
8-30 VDC (40 mA max.)

Operating Temperature:
-50 to 50° C

Dutput Signals:
4-20 mA full scale

CE *Complies with applicable CE directives.*

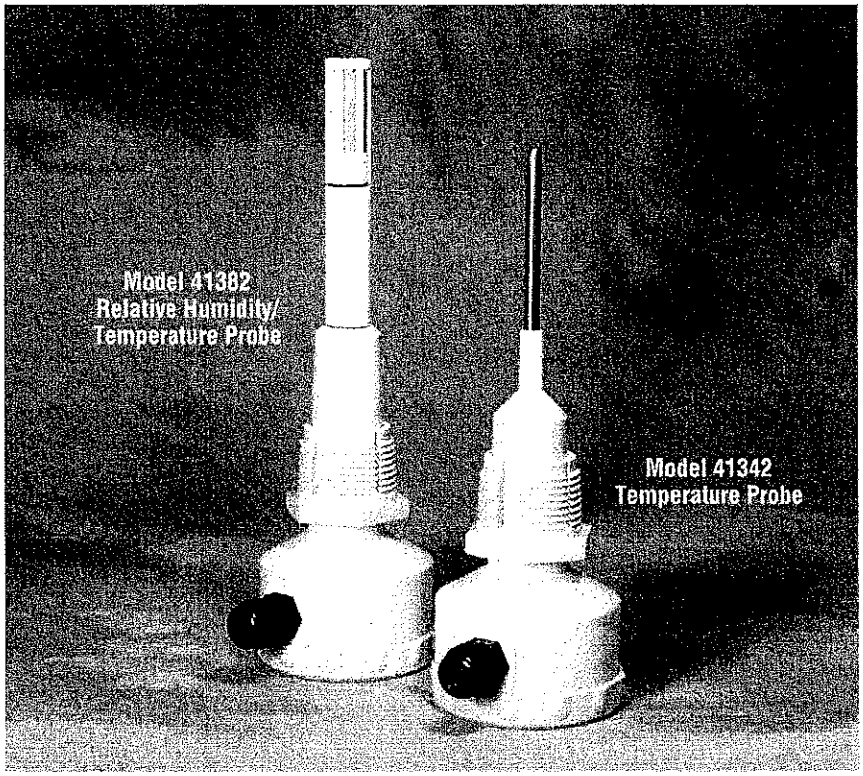
Specifications subject to change without notice.

YOUNG

R.M. YOUNG COMPANY
2801 Aero Park Drive
Traverse City, Michigan 49686 USA
TEL: (231) 946-3980 FAX: (231) 946-4772
E-mail: met.sales@youngusa.com
Web Site: www.youngusa.com

YOUNG

Model 41382 **Relative Humidity / Temperature Probe**
Model 41342 **Temperature Probe**



The Model 41382 Relative Humidity/Temperature Probe combines a high accuracy, capacitance type humidity sensor and precision Platinum RTD temperature sensor in one probe. This probe offers a choice of 0-1 VDC or 4-20 mA outputs for T and RH. **Model 41342 Temperature Probe** offers accurate temperature-only measurement. Three output options are available: 0-1 VDC, 4-20 mA, and 4 wire RTD. Probes are easily installed in YDUNG naturally ventilated (multi-plate) and aspirated radiation shields. A junction box is provided for cable terminations.

Specifications

Power Required:	**41382**	**41342**
V Option: 10-28 VDC	8 mA	5 mA
L Option: 10-28 VDC	40 mA	20 mA

RELATIVE HUMIDITY: (41382)

Measuring Range: 0-100 %RH

Accuracy at 20 °C: ±2 %RH,

Stability: Better than ±1 %RH per year

Response Time: 10 seconds (without filter)

Sensor Type: Rotronic Hygromer™

Output Signal: V option: 0-1 VDC,
L option: 4-20 mA

TEMPERATURE: (41382, 41342)

Calibrated Measuring Range:
-50 to 50 °C (suffix C)
-50 to 150 °F (suffix F)

Response Time: 10 seconds (without filter)

Accuracy at 0 °C: ±0.3 °C**
±0.1 °C (optional) with NIST traceable calibration

Sensor Type: Platinum RTD

Output Signal: V Option: 0-1 VDC,
L Option: 4-20 mA, 4 wire RTD (41342 only)

Recommended Radiation Shields:
Model 41003P Multi-Plate Radiation Shield
Model 43408P Aspirated Radiation Shield

** *Differential measurement recommended with V option.*

Ordering Information

	SENSOR CABLE	MODEL
RELATIVE HUMIDITY/TEMP PROBE 4-20 mA output	**18723**	**41382L***
RELATIVE HUMIDITY/TEMP PROBE 0-1 VDC output	**18446**	**41382V***
TEMPERATURE PROBE 4 wire RTD output	**18723**	**41342**
TEMPERATURE PROBE 4-20 mA output	**18641**	**41342L***
TEMPERATURE PROBE 0-1 VDC output	**18443**	**41342V***

**Specify °F or °C*

CE *Complies with applicable CE Directives*

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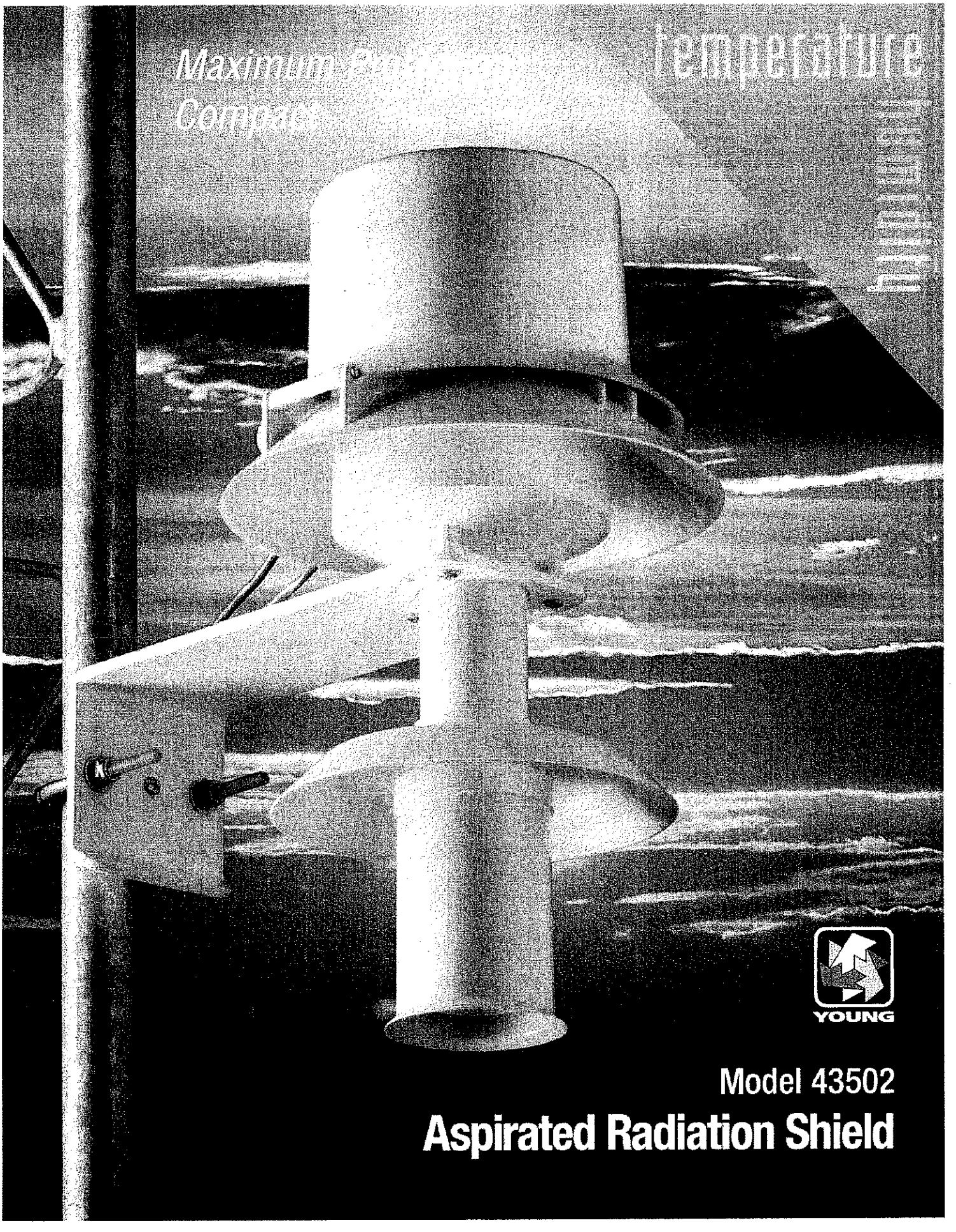


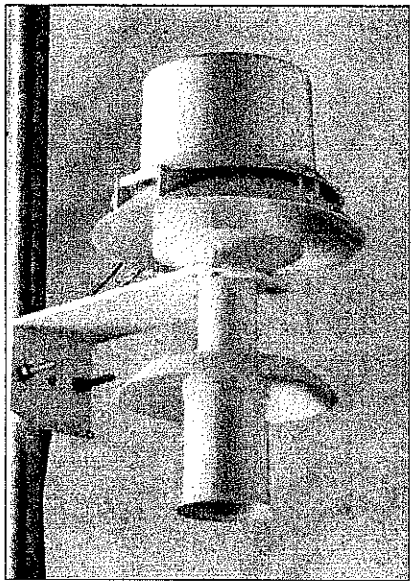
Model 43502

Aspirated Radiation Shield

YOUNG

Model 43502 Aspirated Radiation Shield

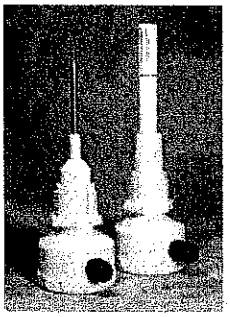
The Aspirated Radiation Shield provides maximum sensor protection from incoming short wave solar radiation and outgoing long wave radiation.



The shield employs a triple-walled intake tube and multiple canopy shades to isolate the sensor from precipitation and solar radiation. A continuous duty blower draws ambient air through the intake tubes and across the sensor, minimizing radiation errors. Compact shield components reduce radiation absorption and improve aspiration efficiency. Specially selected plastic materials provide high reflectivity, low conductivity, and maximum weatherability.

The versatile DC blower is designed for continuous duty of more than 80,000 hours (9 years) at 25° C (77°F). Brushless electronic commutation is achieved using dependable solid state circuitry.

The Temperature Probe is a precision Platinum RTD encased in a stainless steel protective sheath. The sensing element is secured in a convenient junction box that fits YOUNG radiation shields. The probe is available with various output options. The 4-20 mA current output is useful in high noise, industrial settings or for long cable lengths. The 0-1 VDC option provides a calibrated voltage output signal.



The Relative Humidity/Temperature Probe combines a high accuracy humidity sensor and temperature sensor into one compact unit. The probe is available with 0-1 VDC or 4-20 mA outputs to satisfy a wide variety of applications.

Ordering Information — Model

ASPIRATED RADIATION SHIELD	43502
TEMPERATURE PROBE - RTD OUTPUT	41342
4-20 MA OUTPUT*	41342L*
0-1 VDC OUTPUT*	41342V*
RELATIVE HUMIDITY/TEMPERATURE PROBE:	
4-20 MA OUTPUT*	41382L*
0-1 VDC OUTPUT*	41382V*

SPECIFY TEMPERATURE SCALING:

-50 to +50° C	*ADD SUFFIX C*
-50 to +150° F	*ADD SUFFIX F*

CE *Complies with applicable CE Directives*

Specifications

Sensor Types:
Accommodates temperature and humidity sensors up to 24 mm (.94 in) diameter

Radiation Error:
Ambient Temperature: 0.2° C (0.4° F) RMS @ 1000 w/m² Intensity
Delta T: 0.05° C (0.1° F) RMS with like shields equally exposed.

Aspiration Rate:
5 to 11 m/s (16 to 35 fps) depending on sensor size.

Power Requirement:
12-14 VDC @ 500 mA for blower.
AC adapter included.

Construction:
UV stabilized white thermoplastic shield and blower housing
Aluminum mounting bracket, white coated.
Stainless Steel U-bolt clamp

Dimensions:
Overall Height: 33 cm (13 in).
Overall Diameter: 20 cm (8 in).
Shield: 70 mm (2.8 in) dia. x 12 cm (4.7 in) length.
Blower Housing: 17 cm (6.7 in) dia. x 11 cm (4.3 in)

Mounting: V-block and U-bolt fits vertical post or tower members 25-50 mm (1-2 in) dia.

Weight:
Net weight- 1.1 kg (2.5 lb)
Shipping weight- 2.7 kg (6 lb)

Model 41342 Platinum RTD Probe

Sensor Type:
1D00 Ω Platinum RTD

Range:
Temperature: ..... -50° C to +50° C (-50° to +150° F)

Accuracy:
±0.3° C at 0° C ..... (standard)
±0.1° C at 0° C ..... (optional)

Available Outputs:

4 wire RTD	41342
4-20 mA	41342L
0-1 VDC	41342V

Model 41382 Relative Humidity Probe

Sensor Type:
Temperature: ..... 100 Ω Platinum RTD
Humidity: ..... Capacitive Polymer

Range:
Temperature: ..... -50° C to +50° C (-50° to +150° F)
Humidity: ..... 0 to 100% RH

Accuracy:
Temperature: ..... ±0.3° C
Humidity: ..... ±2% RH

Available Outputs:

4-20 mA (10-28 VDC, 20 mA)	41382L
0-1 VDC (10-28 VDC, 8 mA)	41382V

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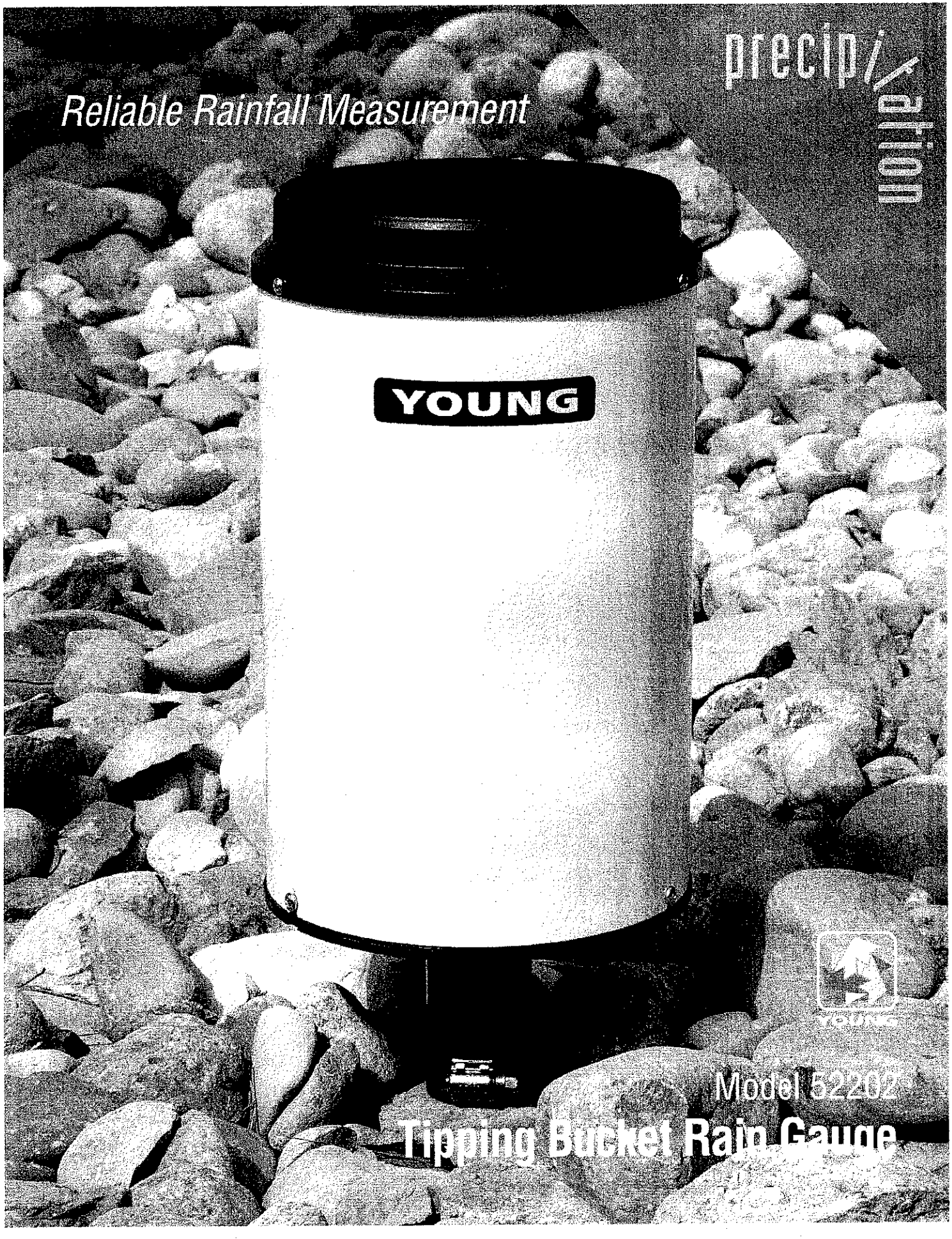
precip/gauge
Reliable Rainfall Measurement
YOUNG
Model 52202
Tipping Bucket Rain Gauge

YOUNG Model 52202 Tipping Bucket Rain Gauge

The YOUNG Tipping Bucket Rain Gauge meets the specifications of the World Meteorological Organization (WMO).

The design uses a proven tipping bucket mechanism for simple and effective rainfall measurement. The bucket geometry and material are specially selected for maximum water release, thereby reducing contamination and errors.

Catchment area of 200 cm^2 and measurement resolution of 0.1 mm meet the recommendations of the WMO. Leveling screws and bullseye level are built-in for easy and precise adjustment in the field. Measured precipitation is discharged through a collection tube for verification of total rainfall.

Model 52202 is heated for operation in cold temperatures. An unheated version, 52203, is available for use in moderate climates.

To discourage birds from perching on the funnel rim, accessory bird wire assembly may be attached to the gauge.

Specifications

Size:
18 cm dia. x 30 cm high, (39 cm high with mounting base)

Catchment Area:
200 cm^2

Resolution:
0.1 mm per tip
0.2 mm per tip (optional)

Accuracy:
2% up to 25 mm/hr
3% up to 50 mm/hr

Output:
Magnetic reed switch (N.O.), rating 24VAC/DC 500mA

Operating Temperature:
-20°C to +50°C (heated)

Power:
18 Watts for heater only

Mounting:
Clamp for 1" (1.34" dia.) iron pipe
or 3 bolts on 160mm dia. circle

Other:
Leveling adjustment, thermostatic control for heater, intake screen

Ordering Information — MODEL

TIPPING BUCKET RAIN GAUGE (HEATED)	**52202**
TIPPING BUCKET RAIN GAUGE (UNHEATED)	**52203**
BIRD WIRE ASSEMBLY	**52250**

CE *Complies with applicable CE directives.*
Specifications subject to change without notice.

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YOUNG

YOUNG Model 61302 Barometric Pressure Sensor

YOUNG Barometric Pressure Sensors combine high accuracy and low power over a wide range of pressures and temperatures.

Model 61302V provides a calibrated 0-5 VDC analog output. Analog current consumption is less than 3 mA. A special "sleep" mode further reduces current to about 1 µA. RS232 serial output is also available in the standard sensor.

Model 61302L features a standard 4-20 mA analog output. Two serial options, RS-232 and RS-485, are included with this model.

The compact size of the barometer allows easy placement in most standard instrument enclosures. A plug-in connector simplifies wiring.

For outdoor use, an optional **Weatherproof Enclosure** offers a convenient mounting location while the **Pressure Port** helps minimize dynamic pressure errors due to wind.

Specifications

Pressure Range:
500 to 1100 hPa

Operating Temperature:
-40 to +60°C

Digital Accuracy*:
0.2 hPa (25°C)
0.3 hPa (-40 to +60°C)

Analog Accuracy:**
0.05% of analog pressure range

Analog Temperature Dependence:
0.0017% of analog pressure range/ °C (25°C reference)

Update Rate:
1.8 Hz max

Serial Output:
Full duplex RS-232
9600 baud
Polled or continuous
ASCII text, NMEA
Half duplex RS-485 (61302L only)

Analog Output:
0 to 5000 mV, 0 to 2500 mV (61302V)
4 to 20 mA (61302L)

Resolution:
Serial 0.01 hPa
Analog 0.025% of analog scale

Power:
7 to 30 VDC
61302V – Vout, 2.8 mA
– Sleep mode, 1.4 µA
– RS-232, 7 mA
61302L – 4-20 mA, 25 mA max
– RS-232 or RS-485, 7 mA

Dimensions:
90 mm (3.6 in) x 60 mm (2.4 in) x 20 mm (0.8 in)

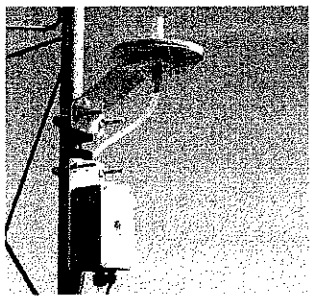
Weight:
44 g (1.5 oz)

* Defined as ±1 standard deviation from NIST traceable pressure reference. Includes non-linearity, hysteresis, repeatability, and calibration uncertainty.

** Defined as ±1 standard deviation from ideal analog output. Total analog output accuracy is the root sum square of digital accuracy, analog accuracy, and analog temperature dependence.

Ordering Information — MODEL

BAROMETRIC PRESSURE SENSOR – 0-5 VDC	61302V
BAROMETRIC PRESSURE SENSOR – 4-20 mA	61302L
WEATHERPROOF ENCLOSURE	61360
PRESSURE PORT WITH OFFSET BRACKET	61002



Weatherproof Enclosure and Pressure Port

CE *Complies with applicable CE directives.*
Specifications subject to change without notice.

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Appendix B

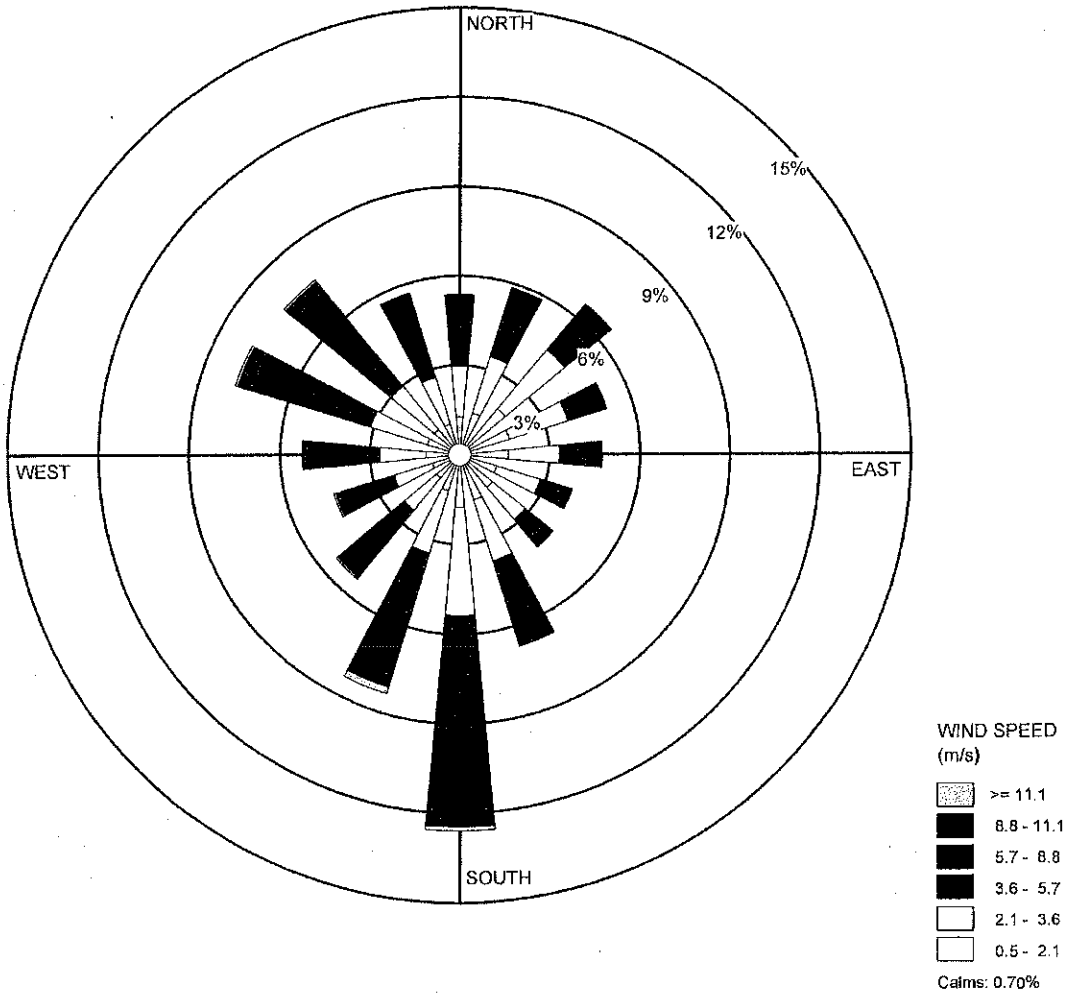
Annual and Seasonal Wind Roses for Lawrenceville, Illinois

WIND ROSE PLOT:

Lawrenceville International Airport, IL (KLWV)
2006-2010 Meteorological Data

DISPLAY:

Wind Speed
Direction (blowing from)

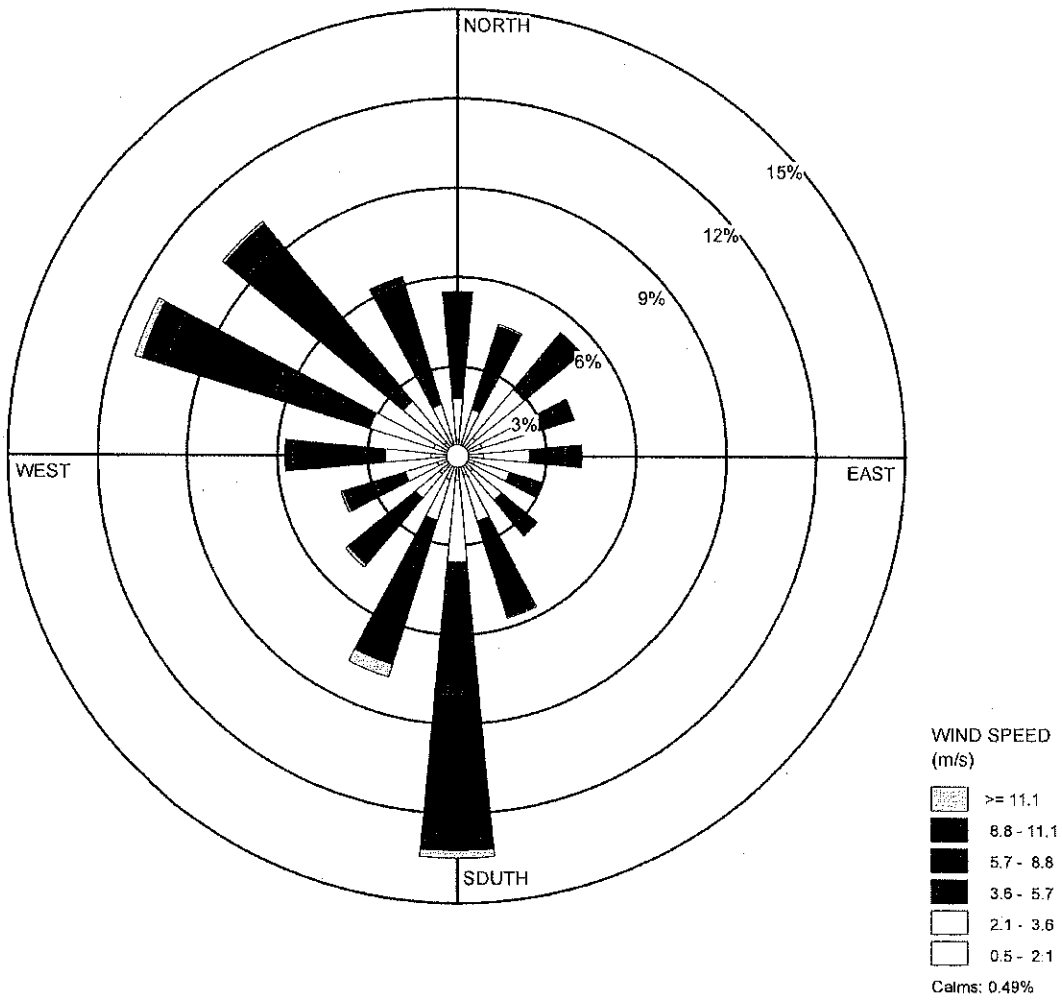


COMMENTS:	DATA PERIOD: **Start Date: 1/2/2006 - 00:00** **End Date: 12/31/2010 - 23:00**	COMPANY NAME: **Peabody Midwest Mining, LLC**	
		MODELER:	
	CALM WINDS: **0.70%**	TOTAL COUNT: **43135 hrs.**	
	AVG. WIND SPEED: **3.94 m/s**	DATE: **1/10/2012**	PROJECT NO.:

WIND ROSE PLOT:

Lawrenceville International Airport, IL (KLWV)
2006-2010 (1st Quarter: January - March) Meteorological Data

DISPLAY:
Wind Speed
Direction (blowing from)



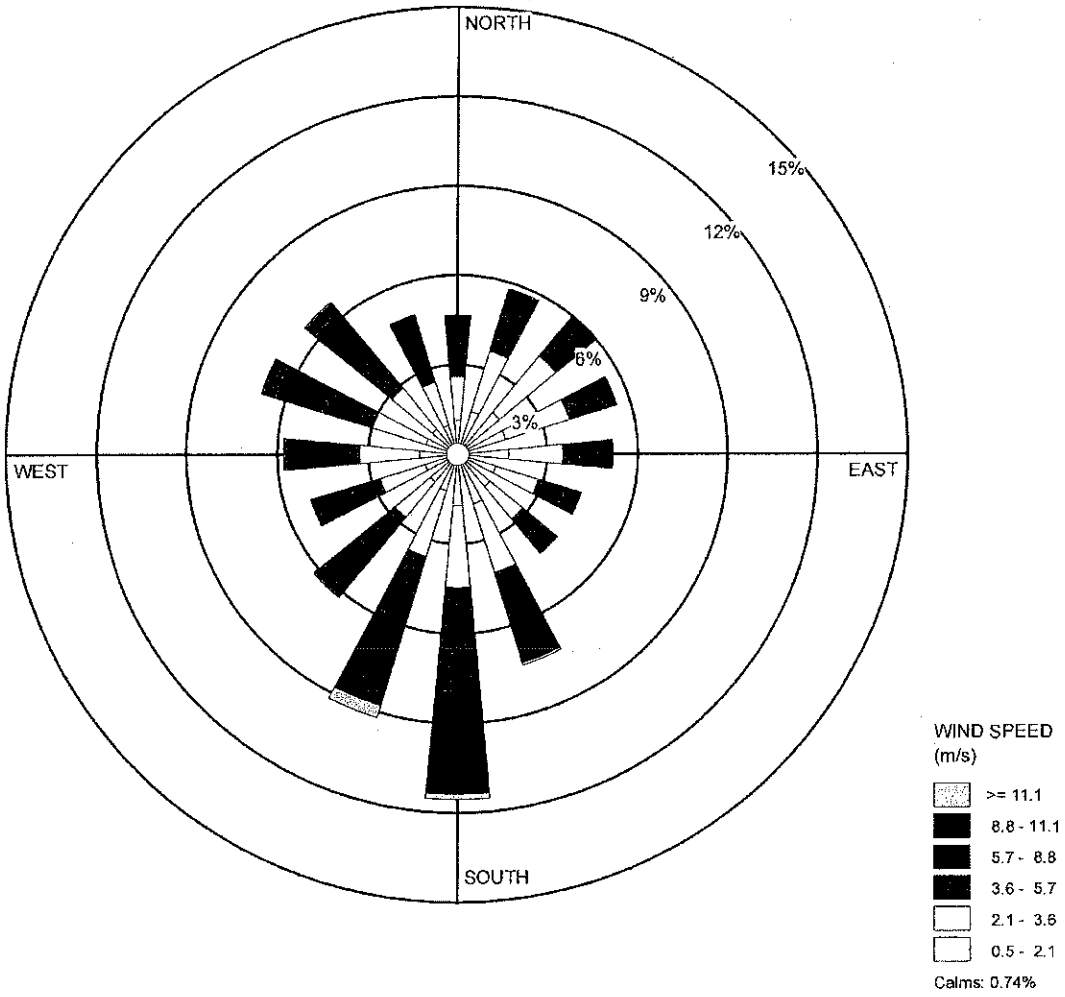
COMMENTS:	DATA PERIOD: **Start Date: 1/2/2006 - 00:00** **End Date: 3/31/2010 - 23:00**	COMPANY NAME: **Peabody Midwest Mining, LLC**	
		MODELER:	
	CALM WINDS: **0.49%**	TOTAL COUNT: **10651 hrs.**	
	AVG. WIND SPEED: **4.79 m/s**	DATE: **1/10/2012**	PROJECT NO.:

WIND ROSE PLOT:

Lawrenceville International Airport, IL (KLWV)
2006-2010 (2nd Quarter: April - June) Meteorological Data

DISPLAY:

Wind Speed
Direction (blowing from)



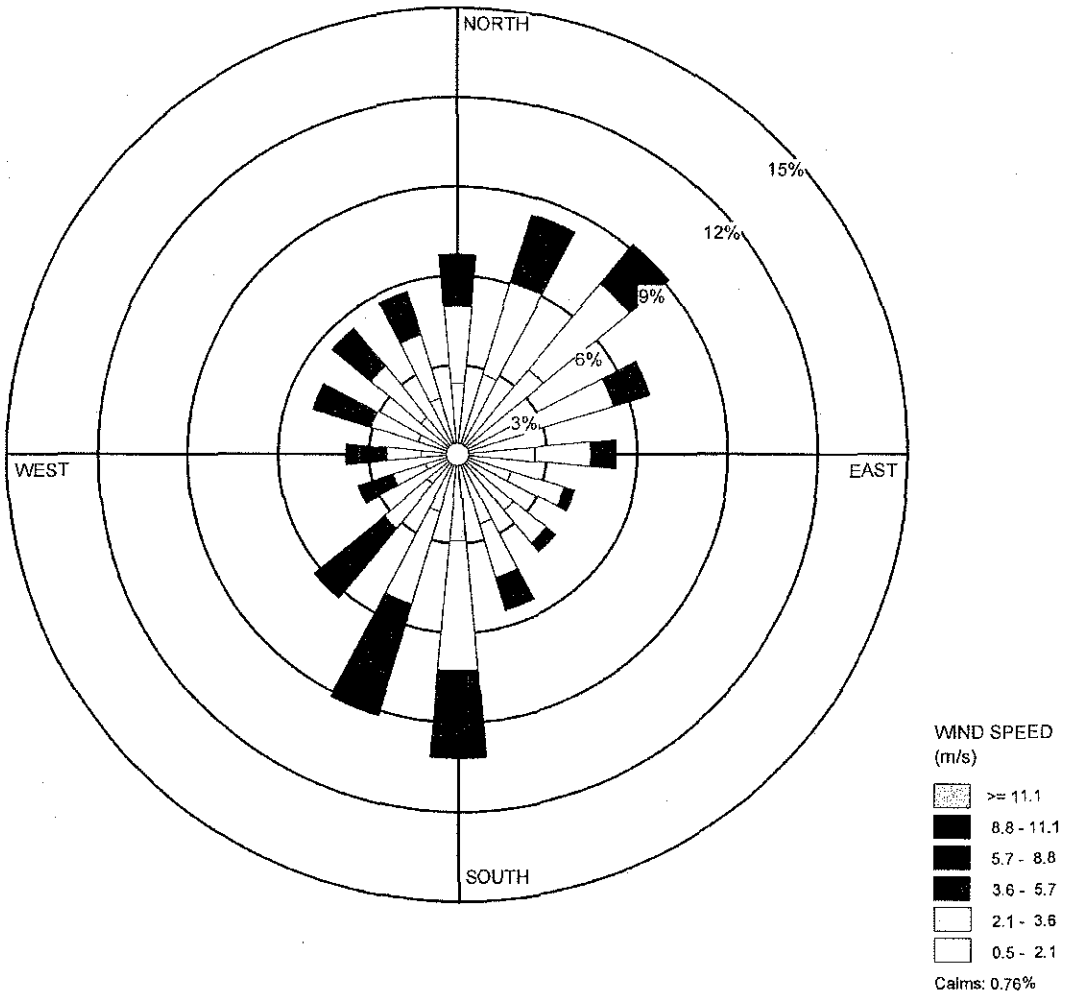
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 4/1/2006 - 00:00 **End Date: 6/30/2010 - 23:00**	**Peabody Midwest Mining, LLC**	
		MODELER:	
	CALM WINDS:	TOTAL COUNT:	
	0.74%	**10462 hrs.**	
	AVG. WIND SPEED:	DATE:	PROJECT NO.:
	3.98 m/s	**1/10/2012**	

WIND ROSE PLOT:

Lawrenceville International Airport, IL (KLWV)
2006-2010 (3rd Quarter: July - September) Meteorological Data

DISPLAY:

Wind Speed
Direction (blowing from)



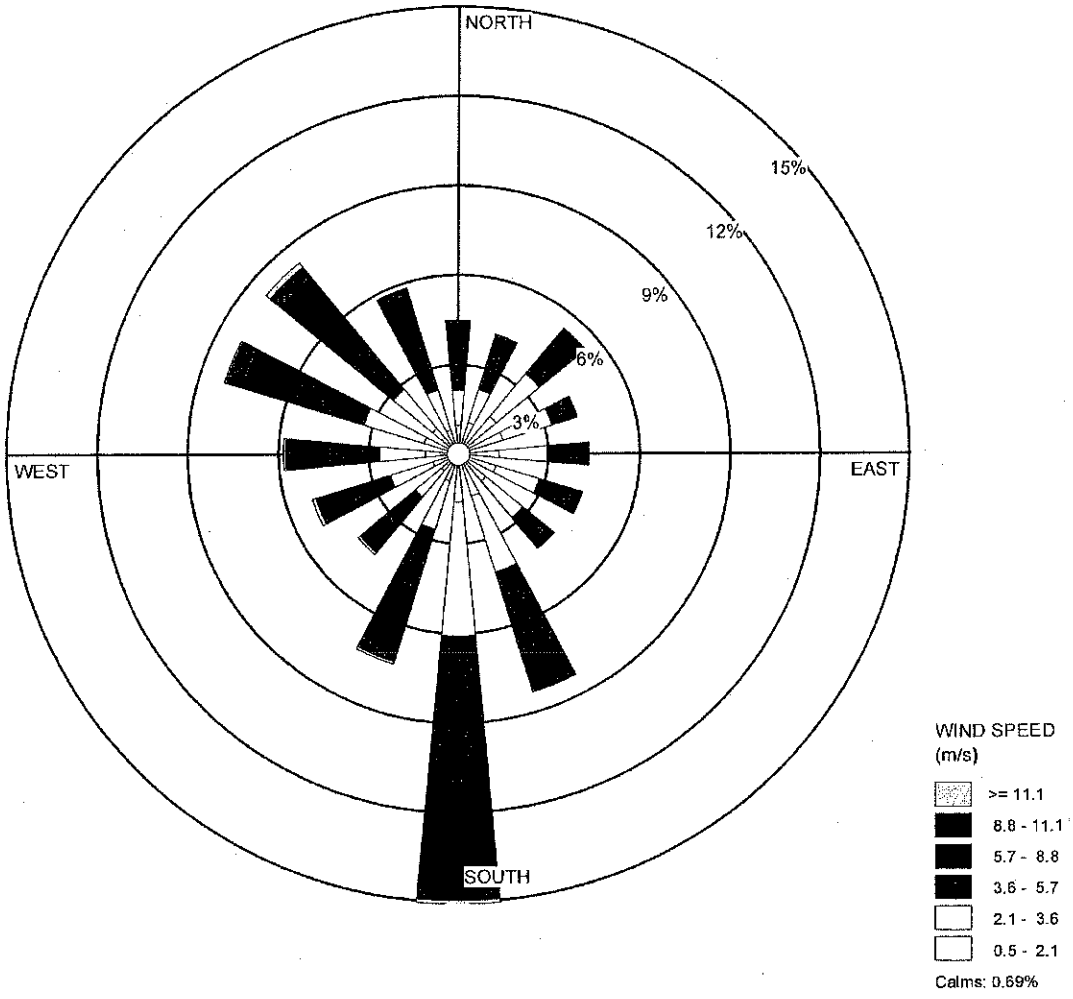
COMMENTS:	DATA PERIOD:	COMPANY NAME:	
	Start Date: 7/1/2006 - 00:00 **End Date: 9/30/2010 - 23:00**	**Peabody Midwest Mining, LLC**	
		MODELER:	
	CALM WINDS:	TOTAL COUNT:	
	0.76%	**10782 hrs.**	
	AVG. WIND SPEED:	DATE:	PROJECT NO.:
	2.91 m/s	**1/10/2012**	

WIND ROSE PLOT:

Lawrenceville International Airport, IL (KLWV)
2006-2010 (4th Quarter: October - December) Meteorological Data

DISPLAY:

Wind Speed
Direction (blowing from)



COMMENTS:	DATA PERIOD: **Start Date: 10/1/2006 - 00:00** **End Date: 12/31/2010 - 23:00**	COMPANY NAME: **Peabody Midwest Mining, LLC**	
		MODELER:	
	CALM WINDS: **0.69%**	TOTAL COUNT: **11000 hrs.**	
	AVG. WIND SPEED: **4.12 m/s**	DATE: **1/10/2012**	PROJECT NO.:

APPENDIX B

M E M O R A N D U M

TO: John Watson, Baker & McKenzie, LLP

FROM: Bill Monnett, McVehil-Monnett Associates, Inc.

DATE: January 10, 2012

RE: Peabody Midwest Mining, LLC Bear Run Mine – EPA Section 114 Request for Information

McVehil-Monnett Associates, Inc. (MMA) has reviewed the U.S. EPA's Clean Air Act Section 114(a) Request for Information, dated November 17, 2011, received by Peabody Midwest Mining, LLC (PMM) regarding its Bear Run Mine located in Carlisle, Indiana. As discussed, the Section 114(a) request includes a request for PMM to collect and analyze three samples of Bear Run Mine coal for lead content. PMM currently conducts monthly sampling of Bear Run Mine coal for lead content. The results of the lead sampling is summarized below.

Lead Content of Bear Run Mine Coal

The attached table was prepared by MMA from laboratory results for lead content provided by PMM and their contract lab. This table shows the average lead concentration of Bear Run Mine coal to be 10.25 ppm. For comparison purposes, the average naturally-occurring background lead content of Indiana soils is 16 ppm. *See USGS Element Concentrations in Soils and Other Surficial Materials of the Coterminous United States, U. S. Geological Survey Professional Paper 1270, U. S. Government Printing Office, Washington, D. C., 1984.* Therefore, the average lead concentration of Bear Run Mine coal is significantly less than the average background concentration in Indiana soils.

Conclusion

Regular lead sampling conducted by PMM at the Bear Run Mine confirms that lead content in Bear Run Mine coal is considerably less than naturally occurring concentrations found in Indiana soils. These concentrations present no risk of exceedances of any Clean Air Act regulatory thresholds or National Ambient Air Quality Standards.

MONTHLY COAL LEAD CONTENT AT BEAR RUN MINE FOR 2011

Month	Location: TE			Location: STK-TE	
	Low Sulfur (µg/g)	Mid Sulfur (µg/g)	High Sulfur (µg/g)	Low Sulfur (µg/g)	High Sulfur (µg/g)
January	11.6	9.5	8.9	9.0	6.2
February	10.8	8.7	7.5	6.7	7.5
March	16.9	12.1	5.8	8.4	8.0
April	7.7	8.9	8.1	10.5	8.7
May	23.7	8.4	8.2	5.7	29.4
June	10.0	8.5	7.1	7.1	8.7
July	11.7	10.7	5.9	6.8	6.6
August	12.1	9.9	7.4	11.5	9.7
September	17.5	9.7	8.2	12.7	7.4
October	11.3	8.3	7.0	8.2	6.8
November	12.9	10.4	9.2	10.9	16.4
December	--	--	--	--	--
Minimum	7.7	8.3	5.8	5.7	6.2
Maximum	23.7	12.1	9.2	12.7	29.4
Arith. Mean	13.29	9.55	7.57	8.86	10.49
Geo. Mean	11.60	9.50	8.90	9.00	6.20

Statistical Summary of Coal Lead Content from All Samples:

Parameter	Concentration (µg/g)
Minimum	5.7
Maximum	29.4
Arith. Mean	10.25
Geo. Mean	9.20